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A COMPETITION FIRE PROOF TEST of a hollow tile arch and a concrete arch of the Roebling type was made in New York city on Nov. 19. The two arches were erected side by side in the same building, and had spans of 5 ft. each. The following are the principal features of the construction of the arches: Arches erected, Oct. 17, 1897; filling above arches put in, Nov. 11; ceiling plastered (Rock Wall plaster), Nov. 12; load applied (150 lbs. per sq. ft., uniformly distributed), Nov. 18; thickness of concrete at crown of Roebling arch, 3 ins.; depth of hollow tile arch, 8 ins.; depth of concrete filling over hollow tile arch, 4ins.; depth of concrete filling over Roebling arch, 2 ins.; proportions of concrete in Roebling arch, 1 part Aalborg Portland cement, 2 parts Cow Bay sand, 5 parts steam ashes (unscreened); proportions of cement mortar in tile arch, 1 part Aalborg Portland cement, 2 parts Cow Bay sand; proportions of concrete filling over both arches, 1 part Brooklyn Bridge brand Rosendale cement (2 parts Cow Bay sand, 8 parts steam ashes unscreened). In the test heat was applied to the two arches at 11.50 a. m, reached 2,000° at about 1 p. m., and varied between 2,000° and 2,300° from that time until 3-6 p. m., when the tile arch fell through at the center. The test was carried out under the direction of Mr. Gus C. Henning, M. Am. Soc. M. E., of New York, N. Y. In our next issue we shall publish the circumstances and results of this test more fully and shall give illustrations of the burned arches.

THE NEW YORK PUBLIC LIBRARY BUILDING is to be designed by Carrere & Hastings, architects, of New York city, according to the final award of the jury appointed. The work of preparing plans has been going on for a year, and in the first competition held 88 designs were submitted; from these, according to the original agreement, six were chosen to take part in the final competition, and six architects who had not submitted designs at the first competition were invited to send in plans. These twelve competitors were: Carrere & Hastings, Cyrus L. W. Eidlitz, J. H. Friedlander, Charles C. Haight, Haydell & Shepard, Howard & Cauldwell, McKim, Mead & White, Peabody & Stearns, George B. Post, H. Hornbostel, G. E. Wood & G. C. Palmer and W. Wheeler Smith. Each of these was to receive $400 and an allowance of $800 for expenses in preparing drawings. These designs were submitted on Nov. 1 to a jury of seven men, three of whom were members of the Board of Trustees, three were chosen by the competing architects and the other was the Director of the Library. This jury picked out three designs, Nos. 11, 5 and 8, as most meritorious in the order named, and submitted them to the Board of Trustees with their comments, and on Nov. 10 the Board opened the envelopes and Carrere & Hastings gained the prize of designing a $1,700,000 building. The Board reserves the right to make any changes in the plans deemed advisable, but the plans themselves are not yet made public.

DISINFECTION OF WATER SUPPLY MAINS and a reservoir at Maidstone, England, was effected a few weeks ago by first emptying the mains and then filling them with water containing bleaching lime. The lime was mixed with the water in a reservoir "by means of jets from a powerful Merryweather steam fire engine." The reservoir walls were washed down by jets of the disinfectant, and the latter was allowed to stand in the mains over Sunday. Only the mains connected with one reservoir were treated, they alone being suspected. These mains distribute water from springs located in an area containing a hop-pickers' camp. It is believed that the excreta from this camp polluted the water from the springs, giving rise to a typhoid epidemic, which at the latest accounts had numbered about 2,000 cases in a population given as 40,000, but not all of which received the infected water. The water supply is furnished by a private company, which has been roundly blamed for allowing such a possible source of pollution to exist. The local authorities have also received no small blame for the occurrence. For information regarding the above disinfection we are indebted to the London "Hospital," and regarding the epidemic to both the "Surveyor" and the "Contract Journal," of London.

SETTLING BASINS, SLOW SAND FILTRATION and a new distribution reservoir have been adopted at Rock Island, Ill., for the improvement of Mississippi River water. For that purpose the city has bought about 25 acres of land on the bluffs, 140 ft. above the business portion of the city and within the city limits. Mr. Jacob A. Harmon has been engaged as engineer for the improvements and the city council has ordered the water committee to begin the work of clearing and excavating for the basins at once, employing day labor. Detailed plans and specifications will be prepared with the idea of letting a contract in the early spring for the parts of the work then undone. The city now has a pumping plant consisting of a 3,000,000-gallon Holly and a 5,000,000-gallon Gaskell pump, pumping direct. It has had a Jewell gravity mechanical filter in operation for some five years. This plant (see Engineering News, May 28, 1896) was a gift to the city and was put in to clarify the water. No alum was used with the filters in 1896. Extra pumping to the height of about 35 ft. was necessitated for the old filters, which, with the auxiliary pumps, will be abandoned. In the new plant the water will be lifted to the settling basins, passing thence by gravity to the filter beds, and finally to the reservoir. There will be two settling basins, each having a capacity of 2,500,000 gallons. The distributing reservoir will have a capacity of 6,000,000 gallons. There will be three filter beds, each with an area of 0.4 acre, designed to give a daily filtering capacity of 3,000,000 gallons, or 2,500,000 gallons per acre per day. This will be the first slow sand filtration plant for a city water supply in the State of Illinois, so far as we know.

EXPERIMENTAL SETTLING TANKS AND SLOW sand filters at Cincinnati have been authorized by the Commissioners of Water-Works, in charge of the new works, operations to be started as soon as the plant can be got ready. The plant will have a capacity of 100,000 gallons a day and will be operated for eight or nine months. The object of the experiments is to determine "under what conditions and at what expense the Ohio River water, under all the varying conditions arising during the winter and spring months of the year, can be purified in a satisfactory manner; this information being necessary to determine intelligently between the merits of the English and mechanical methods of purification." Mr. August Herrman is President of the Commission and Mr. G. Bouscaren, M. Am. Soc. C. E., is Chief Engineer. We are indebted to Mr. Bouscaren for the above information, sent in response to our request

PARIS SUPPLY OF POTABLE WATER has been voted insufficient by the commissioners appointed by the Prefect of the Seine to investigate this matter. The daily consumption is now 129 litres, or 31.2 U. S. gallons per capita, and that this should be insufficient astonishes some members of the commission, who stated that every capital in Europe, excepting Rome, had a less liberal supply than Paris. After much discussion, however, it was decided to seek additional sources of supply and three sub-committees were formed to study the problems presented.

WATER DIVINERS' FEES HAVE BEEN DISALlowed by the auditor of the Local Government Board of England, Mr. A. W. Dolby, in passing on the accounts of the Porthcourt Urban District Council for 1896-7. The fee in question was about $17, besides which the auditor disallowed some $625 expended by the Council in making borings in accordance with the advice of the diviner. The grounds for disallowing the diviner's fee were: (1) That the Council exceeded its statutory authority in employing him; (2) that such employment was void in law because instead of "seeking skilled advice" a person was called in "who claimed to possess some supernatural power;" (3) the payment was illegal because of fraud on the part of the diviner, who wrongfully claimed to know where water could be found, a court decision being cited in which it was laid down that "a man having no knowledge whatever on the subject takes upon himself to represent a certain state of facts to exist, he does so at his own peril, and if it be done with a view to secure some benefit to himself he is guilty of fraud." The reasons for disallowing the items for boring were very much like those given above, with the added one that the expenditure "was a reckless waste of public funds, for which I have, by process of surcharge, properly held accountable those members of the Urban District Council who were responsible for the actual payment of the sums disallowed."

THE USE OF SALT WATER BY THE NEW YORK Fire Department is again being discussed by a commission made up of Fire Commissioner Sheffield, Chief Bonner and Foster Crowell, M. Am. Soc. C. E. Boston already has pipes laid for bringing in seawater for use in extinguishing fires, and Buffalo, Cleveland, Detroit and Milwaukee can use water directly from the lakes in similar cases of emergency. The plan is approved by the insurance companies of New York, and one prominent insurance officer says that a reduction of 5% in insurance rates would be possible on a line of 10-in. pipes connecting with the North River, or within 500 ft. of a hydrant connected with these pipes. Such a pipe system would vastly extend the usefulness of fireboats, by making them effective at long distances from the shore line. The saving in water and damage by fire would more than offset the first cost. As showing the value of the property to be protected, the statement is made that the aggregate value of buildings and property between Chambers St. and 14th St. is at least $500,000,000.

A DISASTROUS FIRE in the business section of Melbourne, Australia, on the morning of Nov. 21, resulted in a loss which is at present estimated at about $5,000,000. From reports it appears that the fire started in the centre of the city, and as a strong wind was blowing at the time the flames spread with great rapidity, destroying practically an entire block in the short space of three hours.

THE GREAT FIRE IN LONDON, of Nov. 15, burned over nearly four acres of buildings and destroyed property valued at about $10,000,000. The buildings were generally large business houses, lying east of Aldergate St., with the centre of the burned district on Well St. The explosion of a gas engine started the fire, at No. 30 Hamsell St., and a strong wind rapidly spread the flames. Starting at 1 o'clock p. m. the fire was checked at 5.30 p. m., after calling out practically the entire London fire department. No lives were lost, but fully 100 business houses were burned. Among the buildings saved with difficulty was the Church of St. Giles, Cripplegate, first built in 1100, partly burned down in 1545, and not rebuilt until about 1600. It escaped destruction in the great London Fire of 1666.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment of a passenger train on the Kansas City, Ft. Scott & Memphis R. R., just west of Williford, Ark., in which a combination coach, chair car and sleeper went down an embankment, the combination car going into Spring River, while the two other cars were burned. The accident, resulting in the death of one person and the injury of some 28, is attributed to a wheel under the combination coach becoming loose and throwing the truck from the rails.

A BOILER EXPLOSION at the Graves Elevator Works, Rochester, N. Y., Nov. 22, besides badly wrecking the buildings and machinery, is supposed to have killer four persons. The boilers, two in number, rated at 80 HP. each, were installed during 1893, and were placed in a small building at the rear of the manufactory, and also supplied power to the Rochester Cabinet Co. It is further stated that the boiler inspector was in the building at the time of the accident and is one of those killed.

THE U. S. ENGINEER SCHOOL, at Willet's Point, N. Y., has been reorganized under regulations for government approved by the War Department. This school is similar to that for artillery at Fort Monroe, and for cavalry and infantry at Fort Leavenworth; the whole course being for post graduates. The object of this school is to increase the professional qualifications of Engineer officers, to conduct research in the branches of science applicable to the duties of the Corps of Engineers, and to prepare manuals for the guidance and instruction of Engineer officers and enlisted men. Officers will be under instructions for two years, with a winter course of theoretic instruction and a summer course for practical instruction. The course includes military engineering, electrical and civil engineering, in the branches applicable to the duties imposed upon the corps. Diplomas will be issued and these will be accepted by promotion examination boards as sufficient evidence of the proficiency of the officers in the subjects indicated.

U. S. COAST DEFENCE ESTIMATES, in the late report of Secretary of War Alger, foot up to $13,378,571, as compared with $9,517,141 for the current year and $6,345,158 for the last fiscal year. He believes that it is wise economy to push this important work forward to its fullest extent. Increases are also asked for in the number of artillery regiments and for the transportation of heavy guns, carriages, etc., an estimate of $2,000,000 is submitted for this latter purpose.

MASONRY-COVERED SAND FILTER BEDS AT ASHLAND, WIS.

The first sand filter beds in the United States to be covered with masonry vaulting are located at Ashland, Wis. They were built in 1895-6, and put into partial operation on Feb. 8, 1896, Mr. Wm. Wheeler, 89 State St., Boston, being engineer. The following information regarding the plant has been taken from a paper by Mr. Wheeler, printed in the Journal of the New England Water-Works Association for June, 1897.

Ashland is in latitude 46° 34′ N., or about the same as the city of Quebec. It is located on the southerly shore and near the head of Chequamegon Bay, an arm of Lake Superior, with a total area of about 56 sq. miles, located as shown on the accompanying map, Fig. 1. The bay receives the drainage from an area of some 300 sq. miles, the runoff of which is at times heavily charged with red clay and mud.

The natural circulation of water in the bay has been materially affected, it is believed, by the construction, in 1890-2, of a breakwater, as shown on the map, and the closing, in 1894, of the gap between the southeasterly end of Long Island and the mainland. Both the above-named pieces of work were done by the U. S. Government.

The population of Ashland increased about tenfold between 1880 and 1890, reaching 9,956 in the latter year, or 11,463, including some adjacent territory properly taken into consideration. The present population is estimated at 15,000.

A public water supply was introduced early in 1884, by the Ashland Water Co. Water was taken from the bay, at a point about 2,000 ft. from the shore, through 16-in. wrought iron pipe. In 1889 a 24-in. cast-iron intake was laid 5,000 ft. into the bay, to 22 ft. of (mean) water, as shown on the map. Beginning with 1888 the city has been gradually constructing a sewerage system, on the separate plan, discharging the crude sewage into the bay at three points on the water front, all west of the pumping station.

The water consumption for the year ending March 1, 1896, averaged 1,343,000 gallons per day, and for the subsequent year 1,340,000 gallons, of which latter some 250,000 gallons was from a large well, mentioned below. The pumping plant now includes two 1,500,000-gallon Gaskill pumps and one 4,000,000-gallon Deane, the latter having been installed in 1894. Direct pumping is employed.

The causes leading to the adoption of filtration are stated by Mr. Wheeler as follows:

> In 1893 and 1894, Ashland, in common with many other communities in northern Wisconsin and Michigan, experienced an epidemic, variously termed by physicians "winter cholera," "typhoid fever," "typhoid malaria," etc. It appeared in small communities having no aqueduct system of supply—in cities whose municipal water sources were open to the suspicion of contamination by sewage, in others where some degree of pollution was certain, and in still others where the purity of the water supply was unquestioned. Among physicians and people there was a division of opinion as to the identity of the disease and the chief agencies of its transmission, but in the minds of some of the leading authorities in the State, familiar with the symptoms of the disease and the conditions under which it appeared, it was thought not to be true typhus, and that other causes than impure water contributed to its wide distribution. The sudden appearance of the epidemic throughout so wide an extent of country, and its equally sudden abatement, seemed to indicate that in some cases, at least, public water supplies were charged with a larger share of responsibility therefor than was their due.
>
> At Ashland, however, the menace to the purity of the water supply which was created by the construction of the city sewers in 1888, supplemented by the alarm to which the epidemic gave rise, led the company to devise measures that would not only satisfy the standards of its own advisers, but also remove any just occasion for alarm upon the part of its patrons and the municipal authorities. To this end, new sources of supply were considered. The open lake was at so great a distance—ten miles in an air line—as to make the cost of going there prohibitive. The extension of the intake beyond the breakwater would still afford a supply from the bay only—subject to discoloration during freshet stages of the streams contributing thereto, and to such modified chances of contamination as would ensue from getting somewhat farther away from the sewers of Ashland, but at the same time nearer to the sewers (present or prospective) of the town of Washburn, situated about five miles away on the other side of the bay.
>
> A daily supply of 325,000 per day free flow to the pump well, or 450,000 per day by pumping, was developed the latter part of 1894 by sinking a collecting well 58⅓ ft. in diameter and 39 ft. deep, and ten 6-in. tubular wells, all on the pumping station lot. The large well overflows at an elevation of 4½ ft. above the lake level, and contains about 740,000 gallons in store below that point. An extension of the tubular well system was originally intended, but Mr. Wheeler states that

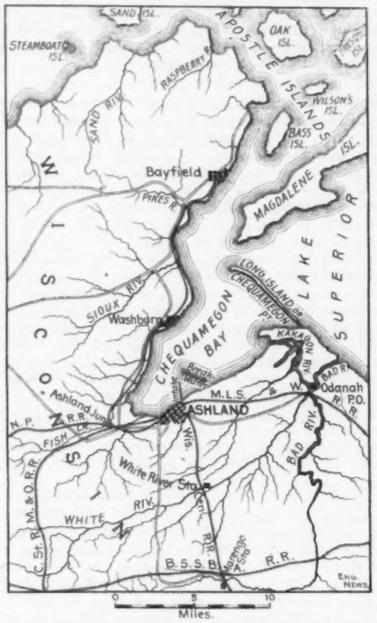


Fig. 1.—Map of Chequamegon Bay, Showing Location of Ashland and Adjacent Towns.

> Meanwhile, the experience of the writer, with various systems of mechanical filtration of public water supplies at other places, and a study of the possibilities of the slower process of sand filtration as illustrated by the open filter at Lawrence, Mass., and also in European practice, so well described by Mr. Hazen in his work on "Filtration of Public Water Supplies," which appeared early in 1895, and by the investigations and reports of others, led to the ultimate adoption of slow filtration through sand as the best solution of the problem.
>
> The policy of the Water Co. upon this question was submitted by the writer in July, 1895, to a committee of citizens and members of the city government, to whom the matter at issue had been referred for consideration and report. The committee reported favorably thereon to the City Council, with resolutions for carrying its recommendation into effect, and upon the 5th of August the report was adopted and the resolutions were passed by the Council and accepted in behalf of the company, which was thereby committed to the construction of an earth and masonry covered filter for the filtration of the entire supply of bay water to be furnished by it.

The area available for filter beds on the pumping station lot was very restricted, the lot, above water, being largely occupied with a pumping station, well, and a siding of the Chicago & Northwestern R. R., as shown in the plan, Fig. 2. It was decided to locate the beds virtually in the bay, "the gradual slope of the bottom, the nature of the material, and the favorable opportunity afforded for placing the works below the level of the lake to operate by gravity" making "the advantages of the site apparent."

The filter beds have a combined available filtering area of about one-half acre, distributed in three compartments, the location and dimensions of which are shown in Fig. 2. No. 1 occupies a portion of the margin, previously filled with slabs and earth. Nos. 2 and 3 were built in water having a mean depth of 4 to 7 ft.

A permanent bulkhead was built around the three water sides of the filter beds. This consisted of two rows of piles and sheet-piling, filled between with material excavated previously from the large well, all as shown in Fig. 2. The finished floors of the filter beds are 7½ ft. below mean low water, and the floor of the pump-well is 2 ft. lower, both floors being of concrete, 3 ins. thick. The outside walls of the filter compartments are 3 ft. thick at the bottom and 2 ft. at the springing line of the covering arches. They are lined with 12 ins. of brick at the bottom and 8 ins. at the top, the main part being of concrete. All piers and partitions are of brick. All the brickwork is laid in Portland cement mortar, 2 parts of cement and 3 of sand. Portland cement was also used for the concrete, mixed with bank sand and beach gravel or pebbles, the parts being 1, 2½ and 5, respectively. The compartments are covered by groined elliptical arches of 15¾ ft. span and 3½ ft. rise, the rings being 5 ins. thick, composed of two courses of brick, laid flat. The masonry construction is shown in detail in Fig. 2, and the interior of the compartments by the views, Figs. 3 and 4.

The permanent load on the piers in Compartment No. 1 is 23,985 lbs. per ft. of horizontal section, and on Nos. 2 and 3 it is 25,460 lbs. The weights were computed on the following basis per

FIG. 3.—VIEW OF FILTER COMPARTMENT NO. 1, READY TO RECEIVE FILTERING MATERIAL.

FIG. 4.—VIEW OF FILTER COMPARTMENT NO. 2, WITH FILTERING MATERIAL IN PLACE.

cu. ft., including absorbed water: Brickwork, 130 lbs.; concrete, 160 lbs.; earth, 115 lbs. A snowfall equivalent to 4 ins. of water would add about 1,450 lbs. per sq. ft. to the above pier loads.

The collecting drains are of sewer pipe, of the dimensions shown in Fig. 2, placed in half-hexagonal depressions in the concrete. An 8-in. centrifugal pump and Westinghouse engine are provided for emptying any compartment through the sump well.

The composition of the filtering material and some facts regarding the construction and operation of the plant, with the cost of each, are given by Mr. Wheeler, as follows:

The sand beds proper have a maximum thickness of about 4 ft. They are supported upon three layers of selected gravel stones of graduated sizes of grain for subdrainage. Of these the first or lower stratum of pebbles has a thickness of 9 ins. at and along the lines of the drains, and 6 ins. midway between them, and next the walls. The second and third layers from the bottom are about 2 ins. and 1½ ins., respectively, in thickness throughout, making the full depth of the beds 5 ft. at the drains and 4¾ ft. midway between them.

The gravel comprising the three strata which support the sand beds (together with that for concrete) was brought from the beach on the north shore of Lake Superior, near Two Harbors, Minn., a distance of about eighty miles, by water transportation. It cost by contract per cubic yard on the dock at Ashland, $1.80 in the fall of 1895, and $1.50 in August, 1896. This material ranged in size of grains from about 0.50 mm. (0.02 in.) in diameter to stones 2 ins. across in their greatest dimension. It was passed over two screens, whereby it was separated into the three desired grades. Of these the coarser—used for the bottom layer—is such as did not pass through a screen having two meshes per lineal inch. That used for the second layer consists of such as passed through the screen of two meshes but not through one of four meshes per inch, while the finer grade upon which the sand rests is of the portion that passed through the screen of four meshes per inch.

The sand used for the filter beds in compartments 2 and 3 was drafted through the suction pipe of an 8-in. centrifugal pump from the bottom of the bay, just inside Chequamegon Point, and was delivered on the dock at Ashland in the fall of 1895 at 65 cts. per cu. yd. by contract.* That used in making the filter bed in No. 1, and in replenishing Nos. 2 and 3, was obtained from the beach at Big Bay, Madeline Island, about twenty-four miles from Ashland by water, and was delivered through manholes into the compartments (but not placed) in August, 1896, at 90 cts. per cu. yd. by contract.

These sands are similar in appearance and character. They are of fine but exceedingly uniform size of grain, that of 1895 from Chequamegon Bay having an "effective size" of 0.27 mm. (0.01 in.), with a "uniformity coefficient" of 1.9, while that of 1896 from Madeline Island has an "effective size" of .40 mm. (0.016 in.), and a "uniformity coefficient" of 1.6, according to the standard of measurement adopted by the Massachusetts State Board of Health in the Lawrence Filtration Experiments. The sand from Chequamegon Bay contained a few gravel stones, which were separated by screening. It was procured during the latter part of October, 1895, and was discharged from scows by pumping into bins on the dock. When the two compartments first completed—Nos. 2 and 3—were ready for their sand beds in December, 1895, and January, 1896, the sand was frozen solid. It therefore had to be thawed and dried by artificial heat before it could be screened or used. For this purpose a multi-tubular furnace was improvised from six 12-ft. lengths of 16-in. water pipe, arranged in a battery of three horizontal flues, each 24 ft. long, and placed 4½ ft. c. to c., and parallel to each other. A 12-ft. length of 8-in. water pipe set up and connected vertically at the spigot end of each flue afforded the draft necessary to maintain combustion in the flues, fuel for which was cheaply and conveniently furnished in the form of slabs. The sand to be heated was piled upon the horizontal pipes and around the vertical ones to the depth of 3 or 4 ft. in a large bin enclosing all but the bell ends, through which the fires were fed. The sand and gravel used for mortar and concrete during freezing weather were also heated in the same manner.

The impervious character of the hardpan, on which the filter is built, and somewhat of the thoroughness with which the coffer-dam and the masonry were constructed are indicated by the fact that the entire amount of seepage into the whole area of the works (all of which drained into the sump well, at a depth of about ten feet below the level of the bay) amounted in 96 hours to about 1,860 gallons, being at the rate of about one gallon in three minutes.

The entire works, with the exception of the filter bed in compartment No. 1, were substantially completed, and the gate in the only connection between the raw water intake and the pumps was closed Feb. 5, 1896,* just six months after the work was determined upon, within which time all plans and specifications had also to be prepared therefor. Thenceforth the entire supply has been filtered with the exception of the ground water overflowing from the collecting well, as above described. The above date is believed to mark the completion and beginning of operation of the first masonry covered filter of its type in America.

The works were designed by the writer, and constructed by day labor under the personal oversight and direction of Mr. Sam Wheeler, Superintendent of the company.

The discharge of the overflow of ground water into the effluent chamber was continued until July 9, 1896, when (in order to permit the taking of samples of the filtered water, unaffected by the ground water, and without temporarily increasing the rate of filtration by its exclusion from the supply during such taking) it was permanently turned into the filtered water pump well.

Compartment No. 1 was provided with its filter bed in August, 1896, Nos. 2 and 3 only having been in service up to that time. The bed in No. 1 was completed and placed in operation Sept. 1, 1896. From Sept. 2 to 8, sixteen inches of sand were added to the bed in No. 2, of which about 11½ ins. represented the sum of the settlement that had taken place in the original bed, and the amount removed in the eleven cleanings thereof since Feb. 5, while the balance, 4½ ins., was an addition required to bring the bed up to its full standard depth. No. 2 was again placed in operation Sept. 8, after which—Sept. 9 to 13—No. 3 (which likewise had been cleaned eleven times since February) was replenished and added to in the same manner, and placed in operation again on the last named date. Since then, all of the compartments having been in constant service, except when being cleaned, the cleanings have been much less frequent than before, No. 1 having been cleaned three times, and Nos. 2 and 3 only two times, each, from Sept. 13, 1896, to March

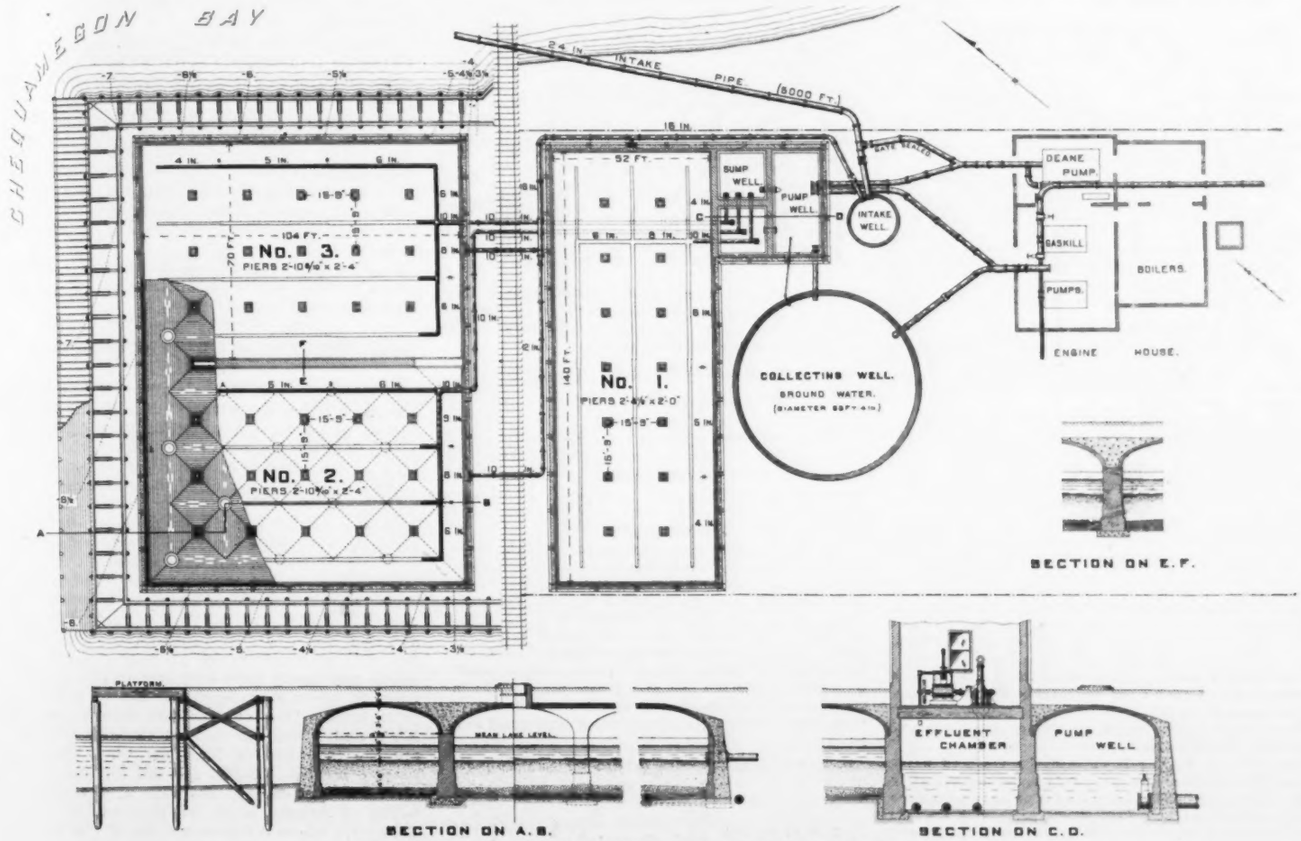


FIG. 2.—PLAN AND SECTIONS OF COVERED FILTER BEDS AT ASHLAND, WIS.

Wm. Wheeler, M. Am. Soc. C. E., Engineer.

*Mr. A. H. Salisbury, Superintendent of the Lawrence Water-Works, informs me (March, 1897,) that it costs 68 cts. per cu. yd. to wash the sand removed from the Lawrence filter, in the process of cleaning, not including the cost of replacing it on the filter bed.—W. W.

*At the suggestion of the writer, this gate was sealed Feb. 10, 1896, in the presence of the City Physician and the Superintendent, who reported March 2, 1897, that the seal "has never been broken or disturbed since."

1, 1897. The greater frequency of cleaning previously required was doubtless chiefly occasioned by the smaller area of filtration then in use, and by the greater turbidity of the water during the spring freshets, but it is believed to have been materially affected also by the fact that several dredges were at work at the ore docks near the station during the summer, and the excavated material conveyed in scows over the outer end of the intake, and dumped into the bay near the breakwater.

The cost of the completed work as made up and classified from the books of the Treasurer and the notes of the Superintendent is summarized as follows:

Coffer-dam:		
470 lin. ft., approximately, exclusive of earth filling		$1,720
Excavation:		
6,983 cu. yds., used in coffer-dam, over arches behind side walls, under railroad, and wasted (of which 700 cu. yds. were handled twice)		3,233
Handling water		493
Brick Masonry:		
340,400 bricks laid in side and partition walls	$6,237	
45,000 brick in piers	827	
349,550 bricks in covering arches (and some in backing)	6,755	
37 manholes, including iron frames covers, and setting in brick work	724	
		14,543
Centers for Groined Covering Arches:		
Materials, erection and removal		1,157
House over effluent chamber and sump well		627
Concrete:		
1,000 cu. yds., in place		5,977
Collecting Pipes:		
Vitrified pipe, laid	$116	
Cast-iron pipe, specials and valves, laid	639	
		755
Supplying Pipes:		
Cast-iron pipes, specials and valves, laid		725
Pipe Connections:		
Between pump well and sump well, effluent chamber, collecting well, centrifugal pump and pumping engines, cast-iron pipe, specials, and valves, laid		729
Filter Beds:		
880 cu. yds., gravel in three lower strata	$1,949	
3,335 cu. yds., sand in upper stratum	4,201	
		6,151
Sundries, not otherwise classified		2,268
Engineering and superintendence		1,800
Total cost		$40,178

With the railroad track out of the way and the entire filtration area of one-half acre constructed in one compartment, the reduction in cost consequent thereon would have been about $2,867.

The cost of the filter was much increased also by the inclemencies of the weather during the months of November and December, 1895, and January, 1896, in which all the masonry of compartment No. 1 and of the effluent chamber, sump well, and pump well, and the sand bed in compartments 2 and 3 were constructed. A careful consideration and estimate of the additional cost due to working in cold weather, short days and night work, indicate that the extra expense occasioned thereby was not less than $2,500.

The sum of these ($5,367) deducted from the actual cost ($40,178) leaves as the estimated normal cost at Ashland of a filter of this type of one-half acre in one compartment (including effluent chamber, pump well, sump well, piping, and housing), $34,811.

In localities where good building stone and suitable gravel and sand are near at hand, this cost should be reduced from 10 to 15%.

The course of procedure in scraping or cleaning one of the filter beds is as follows:

The need of cleaning is indicated by the head under which filtration takes place, which is shown approximately by the difference in level at which the water stands on the bed and in the effluent chamber and pump well, the gate in the effluent pipe being wide open. Under the present practice, cleaning is deferred until the gradual increase in head incident to the arrest of foreign matter on and in the upper part of the bed causes the water in the effluent chamber to fall from 6 ins. to 1 ft. below the top of said bed, indicating that the maximum head for the compartment to be cleaned is from 3 to 3½ ft.

On the day before cleaning, the raw water supplied to this compartment is stopped and the water stored therein continues to drain off through the sand into the effluent chamber until it stands about a foot below the top of the bed—this condition being usually reached by the following morning—when it is ready for cleaning.

The tool commonly used for scraping is a two-edged wooden scraper or hoe, the blade of which, made from a ¾-in. board, is about 15 ins. long by 6 ins. wide, with a handle joined perpendicularly thereto at its center. The two cutting edges are beveled at an angle of about 45°.

The sand removed is usually muddy and somewhat slimy on the top when wet, and forms a slight crust when allowed to dry. The mud and discoloration, which determine the depth of removal, extend from ½ to ¾-in. down into the sand, and impart an adhesive quality to the sand, by virtue of which in cleaning, the scraper seems to follow a line of cleavage between the foul and clean portions of the bed.

After a bed has been cleaned the connection between the ground water well and the filtered water well is partially opened, and the water level in the effluent chamber gradually raised thereby until the newly cleaned bed is fully submerged to the depth of about a foot by the filtered or clear water, after which the raw water inlet is opened, the ground water again excluded, and the cleaned filter is thus again installed in service.

The time required for cleaning one of the beds of one-sixth of an acre is half a day, and the total cost thereof about $8.50, made up as follows:

3 men scraping	½ day at	$1.50 each,	$2.25
2 men wheeling in filter	"	1.50 "	1.50
1 man tending bucket at bottom	"	1.50 "	.75
2 men to land and dump bucket at top	"	1.50 "	1.50
1 man wheeling away on top	"	1.50 "	.75
1 single team to hoist bucket	"	2.50 "	1.25
Tools and sundries			50
			$8.50

This is at the rate of about $50 per acre for cleaning, not including replenishing.

The entire cost of cleaning and maintenance, including that of restoring the sand removed, for one year, to Feb. 28, 1897, is estimated as follows.

Number of compartment cleanings, 29.	
Labor for each scraping, using such men employed about the works as are available, and hiring others at an extra expense of $4.50, but charging all labor employed as above	$8.50
Cost of 29 cleanings	246.50
Average reduction in depth of sand beds, taking all three compartments into consideration, is about 9 ins., to replenish which requires 610 cu. yds., at $1 placed	610.00
Making cost of cleaning and replenishing	$856.50
Add for contingencies and superintendence, 5%	42.87
Total cost	$899.37
Average per cleaning, including replenishing, per compartment	31.01
Average per cleaning, including replenishing, per acre	186.06
Million gallons filtered, March 1, 1896, to Feb. 28, 1897	397.86
Cost per million gallons filtered, not including interest on plant	2.26
The average rate of filtration per acre per day (rated on one-half acre in use) was 2,180,064 gallons.	

The interest charge per million gallons filtered, computed on the actual cost of the plant, at the different rates indicated below, and added to the above cost of operation, gives the following results:

Rate of Filtration 2,180,064 Gallons per Acre per Day.

Rate of interest	Interest charge per million gallons.	Cost of operation per million gallons.	Total cost of filtration per million gallons.
6%	$6.06	$2.26	$8.32
5%	5.05	2.26	7.31
4%	4.04	2.26	6.30

Increasing the rate of filtration within moderate limits, say to not exceeding 3,000,000 gallons per acre per day, would not materially affect the operating cost per million gallons filtered, since the number or frequency of cleanings would be approximately proportional to the rate of filtration. The interest charge per million gallons filtered, however, is inversely proportional to the rate of filtration or the amount filtered. Thus if the rate of filtration were 3,000,000 gallons per acre per day, the interest charge and total cost of filtration resulting therefrom at the several rates of interest indicated would be as follows:

Rate of Filtration 3,000,000 Gallons per Acre per Day.

Rate of interest.	Interest charge per million gallons.	Cost of operation per million gallons.	Total cost of filtration per million gallons.
6%	$4.40	$2.26	$6.66
5%	3.67	2.26	5.93
4%	2.93	2.26	5.19

The cost of operation will vary in different years according to the variable conditions of the problem, such as duration and degree of muddiness of water in the bay, cost of sand, improvement in method, etc.; and in making deductions from the experience at Ashland, for the proper study of the problem of filtration at other places, all such conditions must be carefully compared and considered.

A number of bacterial analyses of unfiltered and filtered water have been made since the filters were put in operation, in accordance with instructions issued by the city authorities, at Mr. Wheeler's suggestion, to Dr. E. D. Perkins, Health Commissioner of Ashland. The analyses were made by Prof. H. L. Russell, of the University of Wisconsin, and are given in detail in Mr. Wheeler's paper. They show poor results, on the whole, but the filter plant was operated a large part of the time under highly unfavorable conditions, and most of the analyses were not begun until the next day after the collection of the samples, which was in gross violation of the well-established principle that bacterial cultures should be made at the time of collecting samples, the lapse of even an hour or two sometimes materially affecting the results. The whole filtering area was not put in operation until Sept. 1, 1896, and the first bacterial counts were made from samples collected about five months later, so that at best the bed had not long been established in good working condition. Moreover, no means for regulating the rate of filtration was in use during the year, although this defect was being remedied when Mr. Wheeler wrote his paper.

The effect of filtration upon the typhoid death rate can be judged more accurately after the filters have been in full operation for a few years. The extremely high typhoid mortality of 1893 and 1894 had ceased before the filters were put in operation, the total number of recorded cases, in fact, being 11 for the year ending March 31, 1896, against the same number for eleven months of 1892-3, the December records for the latter year being missing. For 1896-7 the number of deaths from typhoid was only seven, notwithstanding the increase in population. For eleven months of 1893-4 there were 32, and for 1894-5 there were 40 deaths from typhoid fever, being 18 and 12%, respectively, of the total number of deaths for the periods named, very high rates, indeed. The corresponding percentages for 1895-6 and 1896-7, were 5% and 4%, respectively, showing slightly in favor of the year during which filtered water was used. This favorable showing would have been more marked had not the total deaths from all causes fallen off in 1896-7, but the total mortality was only 175 in 1896-7, against 217 the previous year.

Further results from this filter plant, obtained under more favorable conditions, will be awaited with interest.

A NEW TWO-CYCLE GAS AND KEROSENE ENGINE.

In recent designs of gas engines, it has generally been taken for granted that the four-cycle system of operation invented by Beau de Rochas, and commonly known as the Otto cycle, is the only one on which a commercially successful gas engine could be constructed, notwithstanding its well-known defect of making an explosion in only one out of every four strokes. Numerous attempts were made many years ago to introduce a two-cycle engine, but they all failed in commercial competition with engines of the Otto type. Two new two-cycle engines have recently been constructed in New York city, one for using gas and the other for ordinary kerosene (150° fire test) or other refined product of petroleum, which apparently have sufficient merits to cause them to become successful rivals of the four-cycle type. The engines are known as the Mietz and Weiss gas and oil engines, and they are the invention of Mr. Carl W. Weiss. His patents are Nos. 592,033 and 592,034, dated Oct. 19, 1897. The engines are built at the machine works of August Mietz, 87 Elizabeth St., New York city, where a representative of this journal recently inspected one of the gas engines and one of the oil engines in operation, and saw several others ready for delivery.

The principles of the engines may best be understood from the patent drawings, which we reproduce herewith, although they do not represent correctly the relative sizes and proportions of the several parts.

Fig. 1 represents the gas engine. A is the cylinder, which is surrounded by a water-jacket. B is a trunk piston, the face of which has a curved wedge-shaped projection upon it, as shown. D is the crank pin and E the crank shaft. A closed cast-iron casing surrounds the crank end of the cylinder, the crank and the shaft, forming an air compressing chamber F. G and H are respectively the admission and exhaust ports, both of which are opened and closed by the motion of the piston, which thus performs the function of the ordinary admission and exhaust valves. I is an exhaust chamber which muffles the sound of the exhaust. J is a port admitting air into the compression chamber F, which port is also opened and closed by the piston. K is the gas admission pipe, which delivers the gas through a check valve and into a gas-compress-

ing cylinder L, the piston in which is operated directly by the pressure of the air in the chamber F, its weight being counterbalanced by a helical spring shown above the piston. M is a pipe leading to the gas valve N. The valve is normally held closed by a spring O. The opening of the valve is done by means of an eccentric on the crank shaft operating through a lever P, and the governor mechanism Q R S.

The governor is one of the most interesting features of the engine. In it neither fly balls or other rotating parts of the ordinary centrifugal governor are used. The governor is of the "hit and miss" type, and its office is to allow the valve to be opened each stroke when the speed of the engine does not exceed that for which the governor is adjusted, and to cause it to remain closed whenever the speed increases in the slightest degree beyond the desired speed. This is accomplished as follows: The upper end of the lever P carries a pivot on which is loosly carried the end of a screw-threaded bolt on which are two lock nuts or blocks. The flat side of one of these nuts rests on a block Q which has one portion of its face inclined to the horizontal. The stem of the valve N carries at its end a movable tongue R, which is normally held in a horizontal position by a spring, but is free to move slightly up or down under pressure. The tongue may also be moved slightly in the direction of the axis of the valve rod by compressing the spring S. The end of the tongue is normally brought in contact with the end of the threaded bolt, whenever the latter is thrown to one extremity of its motion by the lever P. When, however, the speed of the engine increases beyond the normal, the inclined face of the block Q causes the nut to be projected, on account of its increased momentum, above its normal position, and so causes the bolt to miss contact with the tongue on the end of the valve rod, and thus to miss opening the gas valve. To the end of the pivoted bolt is fastened a piece of hardened steel with a knife edge and an inclined face, with which the tongue of the valve rod comes in contact, when the engine is running at or below its normal speed. The flexibility of the tongue is important in diminishing the wear to which the contact edges would be liable if made rigid, which wear would diminish the sensitiveness of the governor.

Ignition of the gas is accomplished by means of a hot tube T, which is surrounded by a jacket. From the tubes several ports U U lead to the face of the cylinder head, so as to effect a simultaneous ignition of the charge of gas in the cylinder at several different points.

Below the ignition tube there is a coiled tube V acting as a gas chamber, the use of which is to delay ignition and thus prevent premature explosion, as thus explained by the inventor:

As the charge in the working cylinder is compressed, some of it enters the tube T and is ignited, the tube being in a state of incandescence. The tendency of the flame is to wark back through the channels U U into the working cylinder and it would do so but for the fact that the explosive mixture is passing through said channels from the working cylinder, while the piston is moving to the rear more rapidly than the flame can travel toward the working cylinder, this result being possible by reason of the existence of the chamber V, which permits some of the gas or mixture which passes through the channels to be compressed into it. As soon, however, as the piston has reached the limit of its rearward movement and compression of the charge ceases, the flame travels through the channels into the cylinder and ignites the body of the charge therein.

After the explosion of the compressed mixture of gas and air in the cylinder, its expansion drives the piston forward until it uncovers the admission port G and the exhaust port H. The burned gases escape through the latter while a fresh charge of slightly compressed gas and air enter the former. The curved wedge-shaped projection on the face of the piston diverts the course of the inflowing charge so that it at first occupies the upper portion of the cylinder and drives out the products of combustion through the exhaust port H. The return of the piston closes the port and compresses the new charge to about 100 lbs. per sq. in. before it is ignited.

The oil engine, shown in Fig. 2, is similar to the gas engine, but with some modifications of detail adapting it to the use of liquid fuel. The cylinder A, water jacket B, piston C, compression chamber F, lever P, and governor mechanism Q R S, are all the same as in the gas engine. The governor operates a small oil pump, consisting of a plunger L, operating in a cylinder M, a check valve O, and an admission duct N. The plunger overruns to only a slight extent the opening of the duct N, at each reciprocation, so that it forces forward through the check valve the quantity of oil to be introduced into the working chamber, the rest of the oil in front of the plunger being returned through the duct N. The oil passing the check valve at each stroke enters the working cylinder of the engine through an oil nipple K, which passes through the walls of the cylinder, and has at its lower extremity a valve held closed by a spring. The oil as it enters through the valve is blown off the nipple by the current of air entering from the air compression chamber F, which is deflected horizontally by the curved projection E on the face of the cylinder. It is thus carried into the explosion chamber I, which contains a series of ribs J J. An outer shell surrounds this explosion chamber, to protect it from radiation, an aperture being provided in the bottom of this outer shell through which the inner shell may be heated before starting the engine. When in operation the ribs J J are kept by the heat in the working cylinder at a sufficient temperature to vaporize and ignite the oil. Both the gas and the oil engines are now on the market in sizes from ½ to 25 HP.

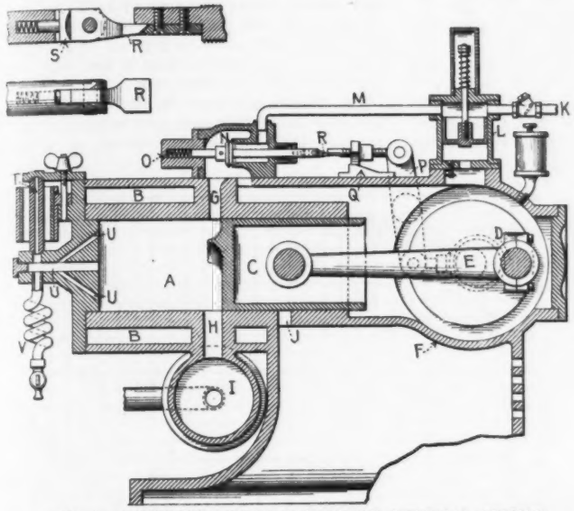


FIG. 1.—A NEW TWO-CYCLE GAS-ENGINE, VERTICAL SECTION.
Patented by Carl W. Weiss, New York.

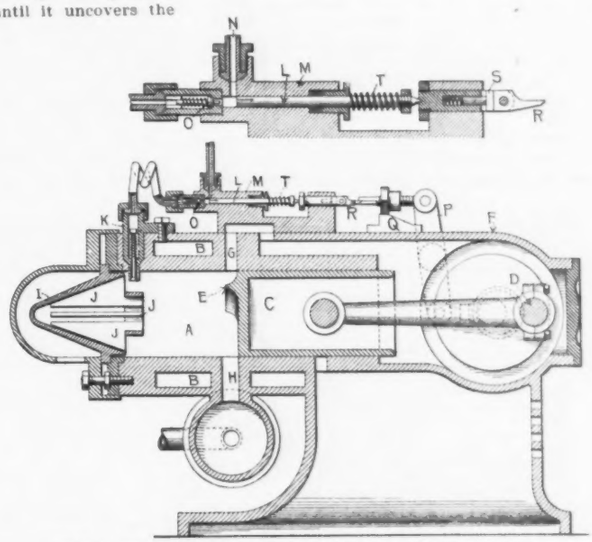


FIG. 2.—THE WEISS KEROSENE ENGINE. VERTICAL SECTION.
Built by August Mietz, 87 Elizabeth St., New York.

THE ENGINEER CORPS AND THE CIVIL SERVICE.

There can be no question that the President's order of May 6, 1896, so far as it related to the engineer department, went too far, in that it included certain classes of employees, such as cooks, carpenters, blacksmiths, etc., whose service upon public works is nearly always of an uncertain and temporary character. These employees are often engaged upon works remote from places where eligible lists are kept. The contingencies of the work more often than not require that they be hired and laid off upon very short notice. A compulsory resort to eligible lists in such cases could not fail to cause a great loss of time, and to rob the service of that elasticity upon which its efficiency largely depends. A literal compliance with the order as it first appeared would unquestionably have caused a great deal of trouble; and to many officers this primary forecast was so gloomy that they at once conceived a strong feeling of opposition to the whole movement. Probably nine out of ten officers, at the time the order was promulgated, considered its application to their department unwise and injudicious. Doubtless a majority still so consider it.

But it is certain that the events of the past year have gone far to remove the fears at first entertained. The engineer department at Washington and the Civil Service Commission have shown a most generous spirit in endeavoring to remove difficulties, make concessions, and to facilitate and simplify the working of the rules. So far have these efforts succeeded that officers now find their operations but little more restricted than before the rules went into effect, while they enjoy the protection which the law was designed to afford.

That this protection was necessary no one familiar with the trend of events in the engineer department in recent years can doubt. Political interference in the appointment of employees in the engineer department has indeed always existed to some extent; but such interference formerly occurred only in isolated individual cases, and never in pursuance of a fixed policy. It is only within the past twelve years that there has become manifest a settled purpose to use the engineer department for partisan ends. But short as this period has been, its record will form one of the darkest chapters in the civil service of the United States. So far, indeed, had this policy been carried that it had found a permanent foothold in the regulations of the army, and it had become a requirement that every important appointment by an officer on his works should first be submitted for the approval of the Secretary of War. That official had then only to substitute for the name of the officer's choice one of his own selection, and return the recommendation "approved," and the business was done with all the formality of the strictest military red tape. This travesty upon the customs of the military service, and the menace involved in thus prostituting a non-partisan branch of the public service to political and partisan ends, were the more dangerous because of their subtle and insidious character. They were veritably a wolf in sheep's clothing, from which protection of any sort could not be otherwise than welcome.

The civil service rules may not secure this protection as perfectly as could be wished. Particularly in the earlier stages of their application, while the old system is still struggling for life, there is no occasion for disap-

pointment if they do not at once accomplish all that was expected from them. But in spite of their shortcomings it is nevertheless true that they offer the only substantial guarantee yet presented against the evil results of political control of the public service.

An Engineer Officer, in "Harper's Weekly."

SOME FEATURES OF MODERN ELECTRIC RAILWAY AND POWER GENERATORS.

(With two-page plate.)

In the voluminous discussion concerning high speed electric traction which has been going on for some years, the matter of machines to produce the necessary electrical energy has hardly been mentioned. The reason for this is that progress in the design of such machines has reached so advanced a stage that the generation of current is no longer a doubtful part of the problem.

The fact that the design of a dynamo, which no more than 15 years ago was almost wholly an empirical process, is to-day as much a matter of exact calculation as the computation of strains in a bridge truss was well shown by Prof. F. B. Crocker, in his presidential address before the Institute of Electrical Engineers, published in our issue of Sept. 9.

Upon our inset sheet this week and in drawings accompanying this article are shown views of several generators, of recent design, for electric railways and power transmission plants which may be taken as fairly representing the best American practice at the present day in this field. All these machines were designed and built at the works of the General Electric Co., at Schenectady, N. Y., and we are indebted to the courtesy of that company for the prints from which our engravings have been made. The machines on our inset sheet are all multipolar compound wound generators designed for direct connection to the engine shaft. The machine in the cut herewith is a large size belted generator. All have slotted armatures and all but the 425 K-W. machine have fields of the ribbed or channel type. The latter has a "solid" field.

The railway generator of to-day, of which the machines here illustrated may serve as good examples, is the result of costly experiments and careful study, and the curves in Fig. 1, which have been plotted from the figures given in Table I., show just where present practice stands as far as dimensions are concerned.

TABLE I.—Dimensions of Various Details of General Electric Generators.

	—Direct connected.—			Belted.	
Kilowatts	150	525	1,600	425	150
Voltage	550	550	600	550	550
Revs. per min.	200	100	75	150	400
No. of poles	6	10	16	6	6
Diam. of field, ins.	86⅞	147	194	118½	68½
Width of field, ins.	16	20	30	25	10½
Thickness of yoke, ins.	3	5	11½	6¼	3¾
Diam. of armature, ins.	45¼	88½	130	65½	37½
Width of armature, ins.	30⅞	40½	46⅛	38¾	18
Diam. of shaft, ins.	9	16-18	24-27	16	6
Length, ins.	95½	168½	232	134	87¼
Width, ins.	54¼	63	79	68⅝	71¼
Height, ins.	75½	117½	145	101	71
Commutator diam., ins.	32	62	100	43½	24¾
Commutator face, ins.	8	..	12	10	4⅞

A fair idea of the relation existing between different sizes of these machines and the general trend of improvement may be obtained by an examination of these curves. Starting, as is usual in dynamo calculation, with the armature, the two curves for which are marked A and A', it will be seen that from 500 K-W. up to 2,000 K-W. the length of armature parallel to the shaft is almost the same, while the outside diameter increases much more rapidly as the output increases. The commutator curves C C' are nearly parallel to A, showing that the lengths remain almost constant for different outputs, but the diameters vary with the armature diameters. Curves F F' and F'' indicate the width of field frame parallel to the shaft F', remaining nearly constant to correspond with curve A' of the armature; the outside diameter F increasing quite decidedly and nearly parallel to A or the outside of the armature and the thickness F'' increasing slowly. The parallelism of F and A shows that the radial length of field cores or the part on which the wire is carried remains about the same, more cores being inserted as the field diameter is increased. The space occupied by the different sizes is shown by curves S S' and S'', and here also the variations follow the increasing size of the armature, as shown by S A and F.

This type of machine is built with 6, 8, 10, 12 and 16 poles and for speeds ranging from 250 down as low as 75 revolutions per minute, depending on the size and output of the machine. The circular field magnet frame is of a special grade of cast-steel of very high permeability, permitting a small frame section and, naturally, smaller dimensions and weight than cast-iron. The frames are ribbed at the outer edges to give the necessary rigidity to withstand the powerful pulls exerted by the field magnets when the machines are in operation. The poles and pole faces are of cast-steel, in one piece, machined to size and secured to the field ring by bolts. As the base of the poles and planed flat it is possible to remove the field cores to put on or take off the field spools, and this without in any way disturbing the armature or field ring.

The frames are made in two sections for convenience in construction and repairs. This also permits the placing or removal of armatures without the great risk of injury common in other types. The necessary brushes are mounted upon suitable studs supported by, but well insulated from, a light but substantial cast-iron ring, which is in turn supported by four brackets projecting from the frame and is free to be rotated by a hand wheel. Owing to this it is possible easily to bring all the brushes to the neutral points, although the action of most of these generators is such that after once adjusting very little change is needed under varying load.

The series and shunt cores are wound side by side in separate sections of the round spools. This form is adopted as it occupies the least space and uses the least material for a given number of turns, and is also easiest to construct. The series winding is a flat copper strip occupying the entire width of one section of the spool, while the shunt winding in the other section is of copper magnet wire. This side by side winding is an improvement on the older forms, in which the shunt field was wound upon the series, since it permits better radiation of the heat generated

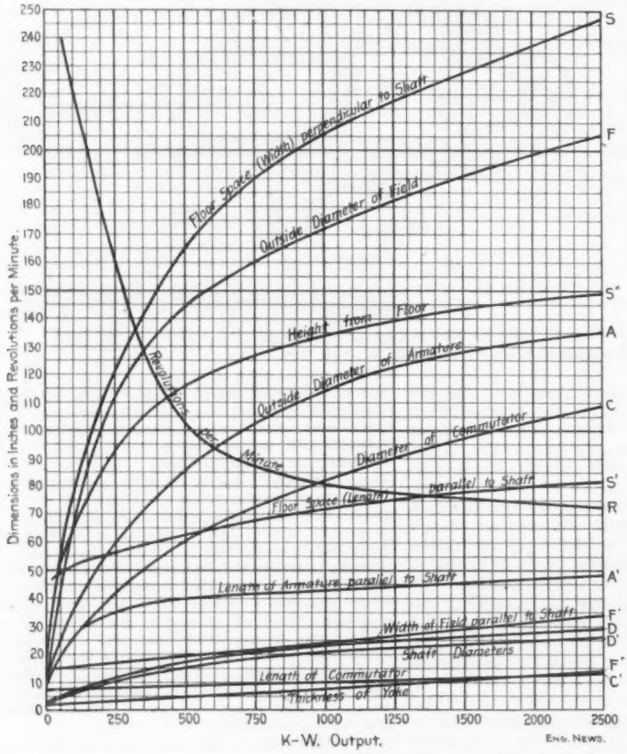


FIG. 1.—DIAGRAM SHOWING COMPARATIVE DIMENSIONS OF DETAIL PARTS OF GENERAL ELECTRIC MULTIPOLAR DIRECT CONNECTED RAILWAY AND POWER GENERATORS.

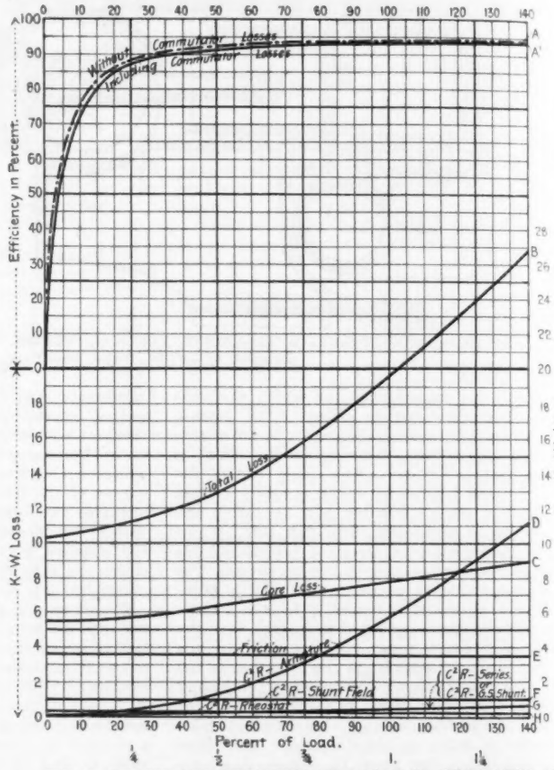
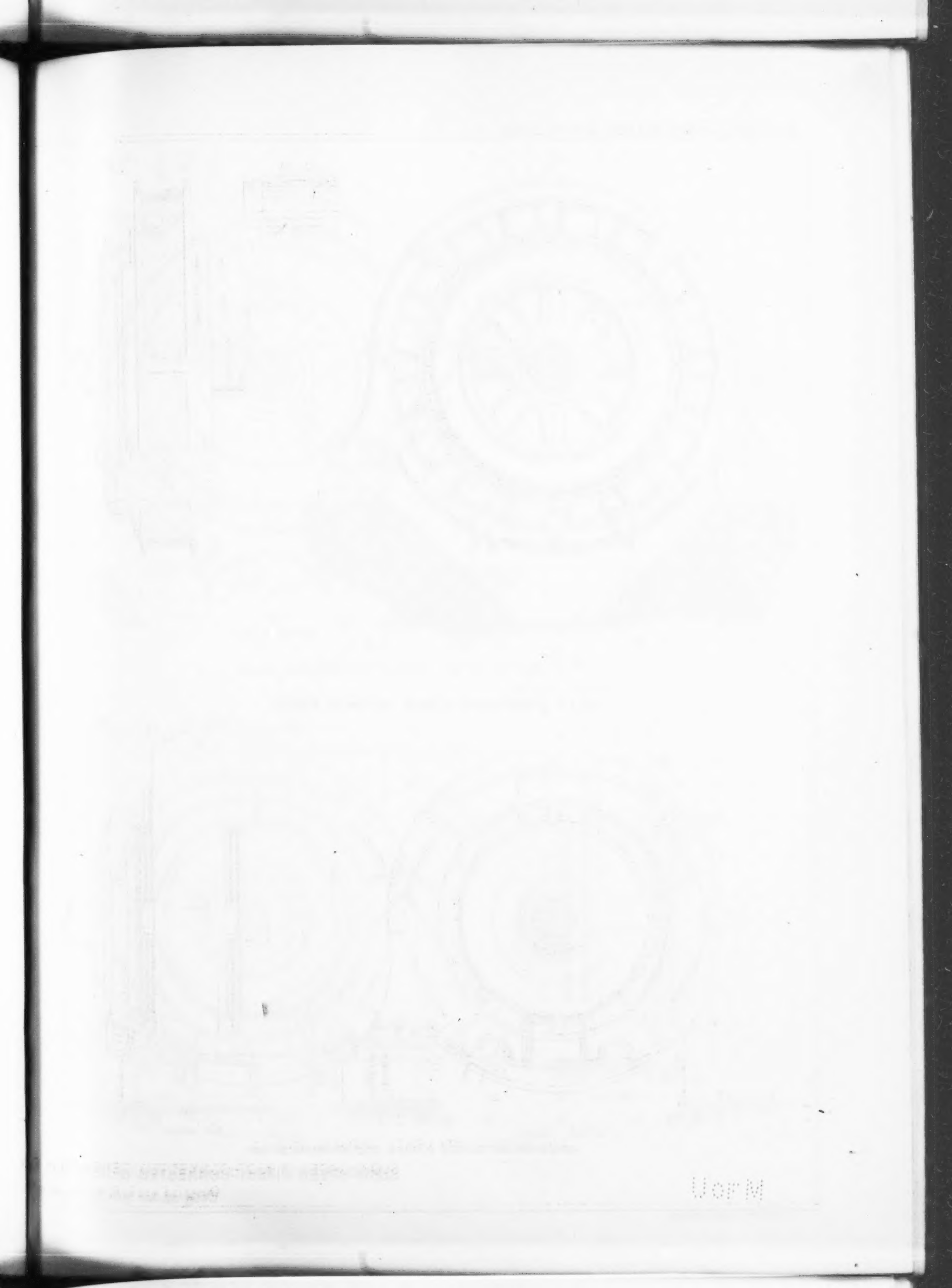
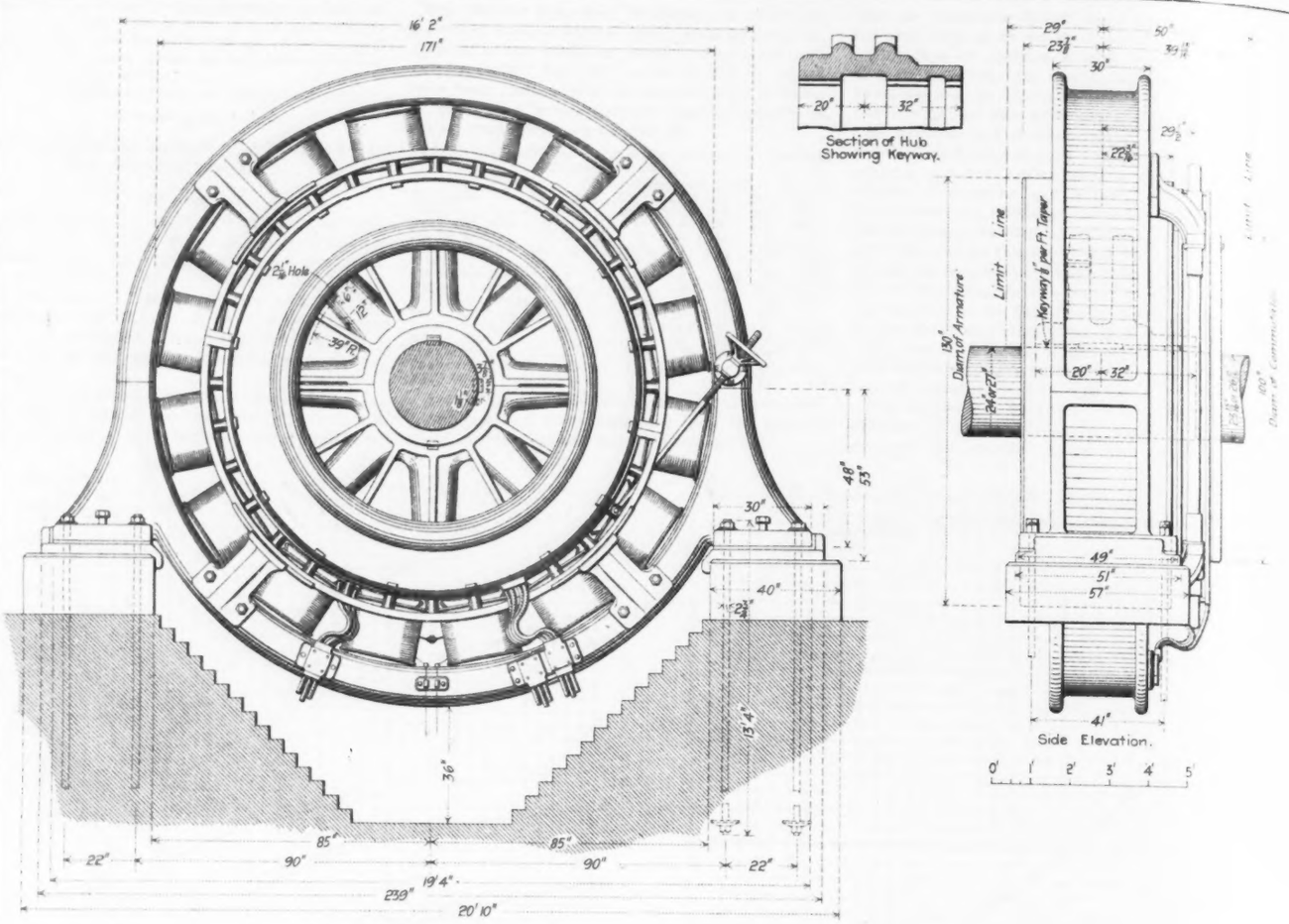
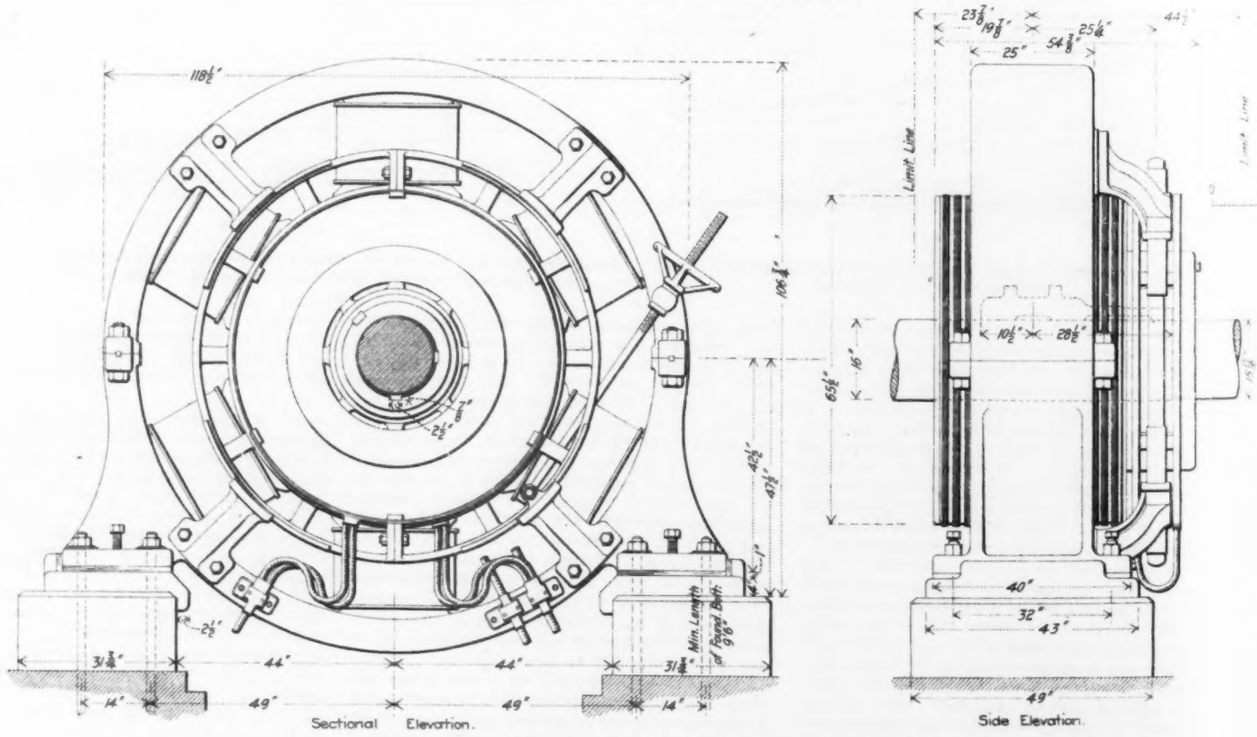


FIG. 2.—LOSSES AND EFFICIENCY OF A 325 K-W. GENERATOR AT DIFFERENT RATES OF SPEED.





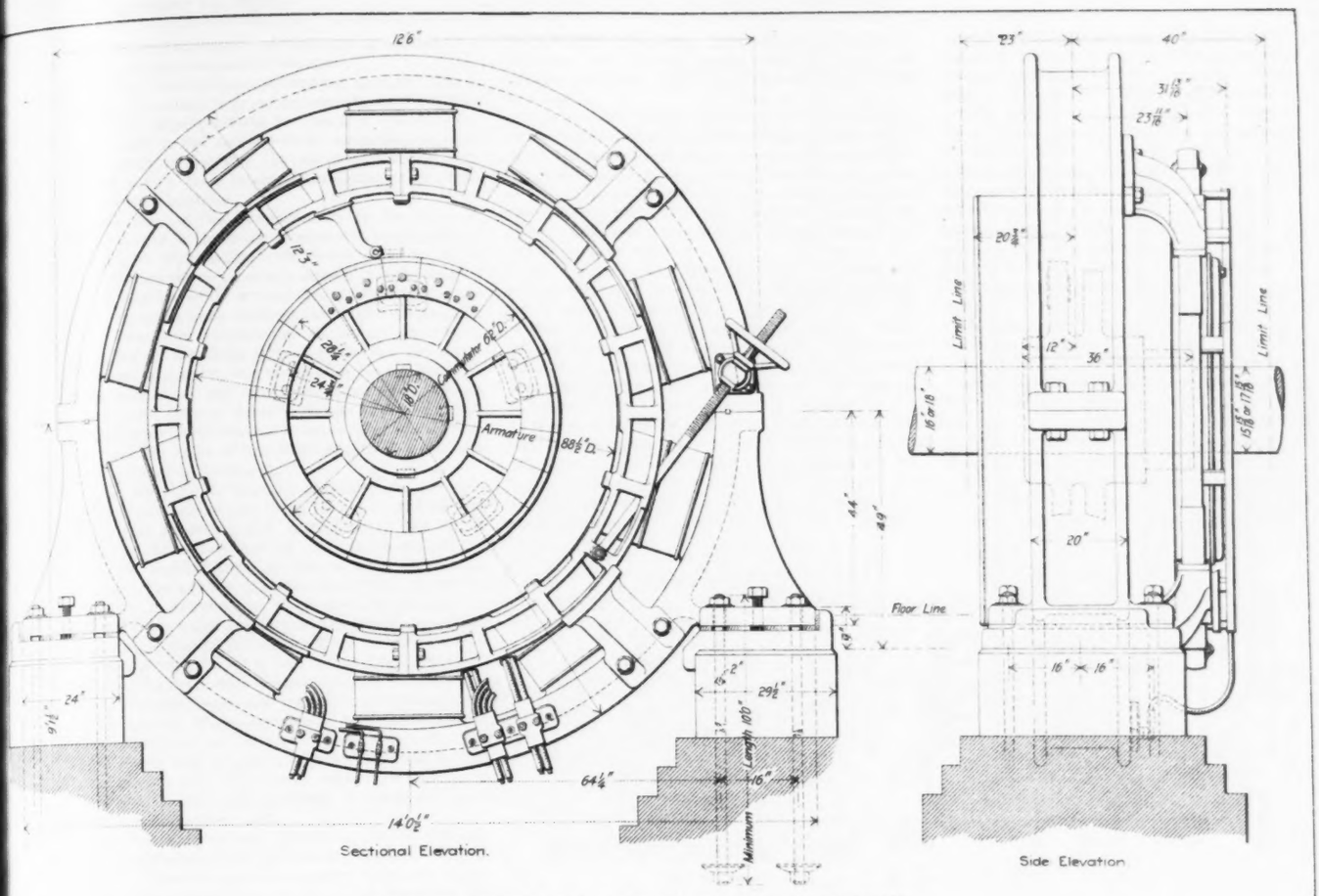
1600 K-W. GENERATOR WITH 16 POLES. VOLTAGE 600, SPEED 75.



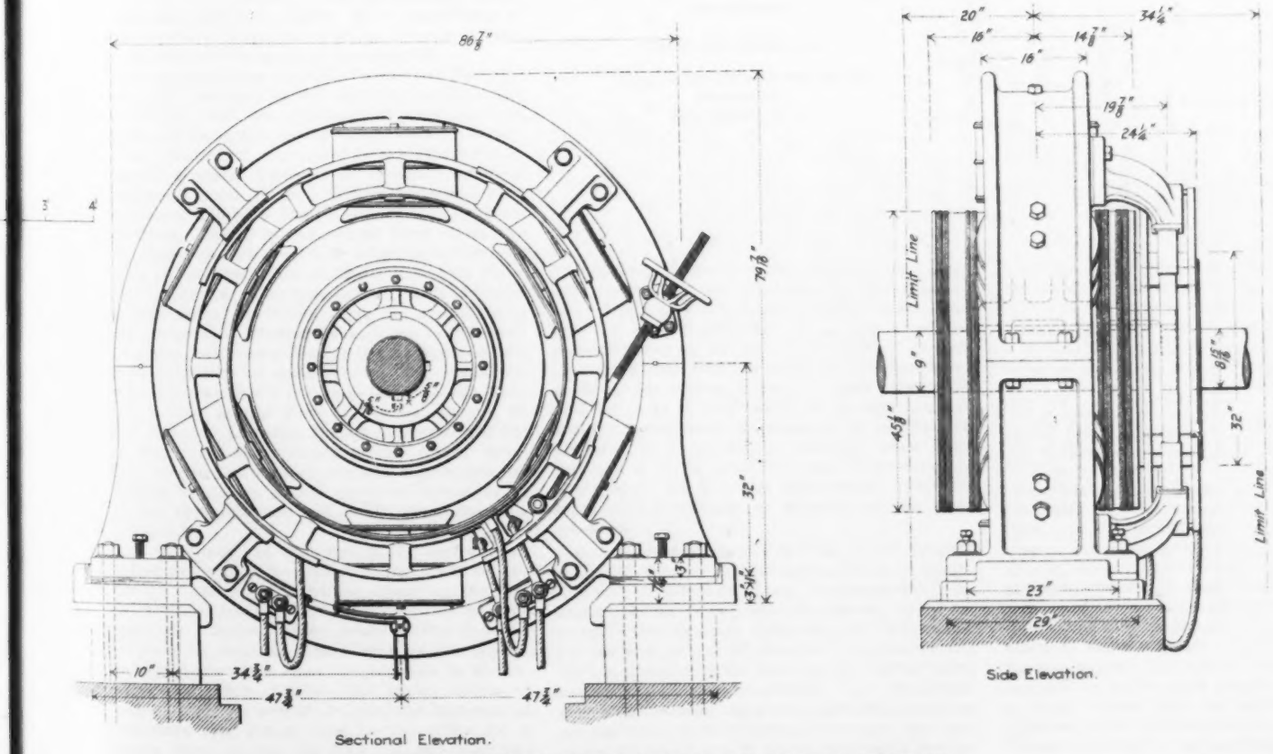
425 K-W. GENERATOR WITH 6 POLES. VOLTAGE 550, SPEED 150.

SLOW-SPEED DIRECT-CONNECTED GENERATORS FOR

Designed and built by The Gener



525 K-W. GENERATOR WITH 10 POLES. VOLTAGE 550, SPEED 100.



150 K-W. GENERATOR WITH 6 POLES.- VOLTAGE 550, SPEED 200.

ORS FOR ELECTRIC RAILWAYS OR POWER TRANSMISSION.

General Electric Co., Schenectady, N. Y.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

and facilitates repairs, should any be needed as a result of carelessness or accident.

In the illustrations, excepting the one belted machine, the bearings are not shown, as the armature and engine shafts are usually one forging, especially in the smaller sizes, necessitating only one outboard bearing. In all cases bearings are made larger than in usual machine practice to insure cool running.

The core of the present type of armature is constructed of a large number of punchings of very soft iron made with great care so as to avoid filing the slots, which results in an increased core loss or eddy current loss. These laminae are mounted upon substantial cast-iron spiders, and cast-iron flanges are bolted on each end, forming at the same time a clamp for the laminae and a support and protection for the projecting portion of the armature windings. Owing to the new form of winding in use at present, it is found possible to make the armatures quite short so that the ratio of armature length to armature diameter is less than ½.

The old style of winding requiring the long involute end connectors is no longer employed and all direct connected and, in fact, all of the larger sizes of armatures are of what is known as the "barrel wound" type, so named because the armature has square ends and somewhat resembles a barrel in appearance. This permits of the cores being made upon formers and carefully insulated before placing in the slots. This method also allows the removal of a coil or conductor without disturbing more than a small portion of the winding, whereas in the old type of drum armature it was usually found necessary to remove nearly all conductors to make repairs on one coil. The projecting end connectors are supported by the flanges, already mentioned, which also serve to prevent oil from the bearings working out upon the armature insulation.

As the spiders are provided with vanes and the laminations with air ducts, excellent ventilation is effected, since the rapidly revolving armature draws in air at the hub and forces it out through the ducts and about the whole outside armature surface and pole faces much like a blower. Owing to the barrel-shape and the blower action the amount of cooling possible is remarkable; this one factor alone permitting a much higher rating for a given weight of machine than would be otherwise possible.

The commutators are built upon cast-iron spiders quite as open as the armature to allow for ventilation and are composed of best selected mica and segments sawed from rolled copper rods. The larger number of coils now employed insures a small difference of potential between segments, which in turn insures permanency of insulation and to a certain extent freedom from sparking. Owing to the present form of clamping segments and the heavy pressure secured by bolts the segments are so firmly locked in place that the danger of loose or low segments is largely eliminated. As constructed, the commutators are complete in themselves and can be removed from the shaft irrespective of the armature should it be necessary to make repairs. In connecting armature conductors to commutators all the leading is done in the plane of the conductors, so that it is only necessary for the commutator studs to project radially outward to this plane. Suitable canvas end dust covers and substantial retaining bands are placed about the armature to protect the insulation and firmly clamp the coils in place.

In examining the drawings of the various machines in detail a few minor changes will be observed. These are additions, made as the size of machines increase to reduce the cost of construction. The one belted machine (Fig. 3) is introduced to show the general style of this type of machine; the other sizes varying only in dimensions and minor details. The higher speeds of belted machines permit of a smaller diameter of armature and fewer poles in the fields for a given size. So far the sizes, construction and general characteristics of railway generators, as exemplified in a standard line of machine, have been briefly considered. It is next quite proper to examine the various losses, large or small, occurring and their effects upon the efficiency of the machines.

We remarked at the outset that the art of dynamo design had reached an advanced stage. How nearly a perfect efficiency the modern generator reaches is little understood by the general public or even by all engineers, we have therefore thought it worth while to present an analysis of the various losses which occur in machines of the type here illustrated.

The curves in Fig. 2 are plotted from data obtained during a test of a 325 K-W. belted generator similar in design to the one here illustrated. While, excepting the efficiency curve, these curves are not directly applicable to any machines, other than the one tested, they serve to indicate the general disposition of the energy furnished to the shaft of any generator by the engine or driving belt. In the upper portion, devoted to efficiency curves, the ordinates represent efficiency in per cent, while the abscissas are per cents of load, 100% meaning an output of 325 K-Ws., 50% 162.5 K-Ws. and so on. The vertical dash lines mark ¼, ½, ¾ full and 1¼ load.

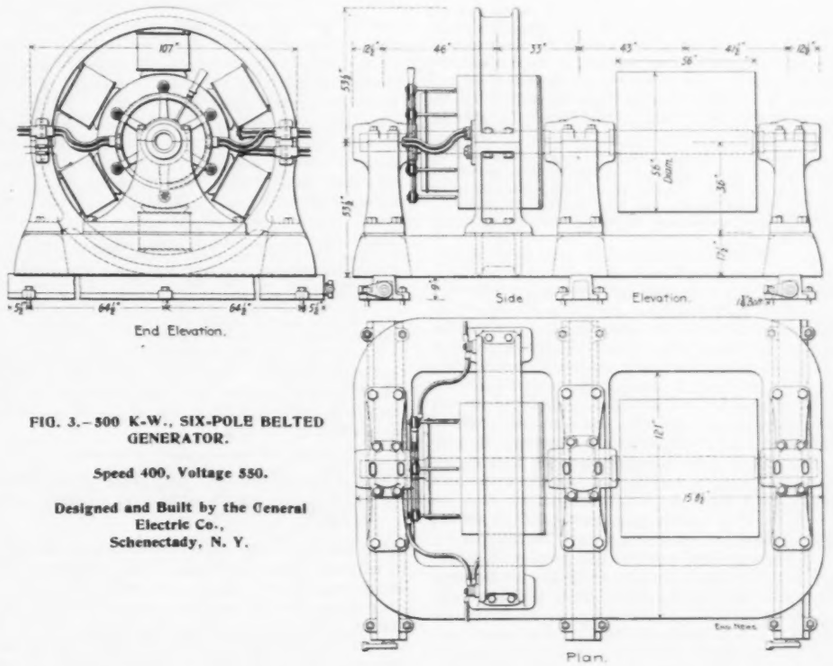


FIG. 3.—500 K-W., SIX-POLE BELTED GENERATOR.

Speed 400, Voltage 550.

Designed and Built by the General Electric Co., Schenectady, N. Y.

The efficiency curve or curves A and A' (the outer one representing the efficiency without commutator losses and the inner including them), run up very rapidly and even at ⅛ load show the high efficiency of between 76 and 79%. At half load these machines, as would be expected after studying the curves of Fig. I, range between 90 and 92%. At ¾ load, which is perhaps the average running load of machines in general, an efficiency of 93 or 94% is obtained, while from full load to one-quarter overload the efficiency is about 94%. As was previously stated, these efficiencies are equalled or exceeded by the large machines.

Before considering the several curves marked core loss, friction, etc., a word or so of explanation will be necessary. Like all machinery, generators, or as more generally known, dynamos, have certain internal losses directly responsible for the high or low efficiency of the machine and the reduction of these losses is the aim of every builder of electrical machinery. In a generator, generally speaking, we may consider the total loss are made up of: Core losses in armature and field cores; friction losses in bearings, brushes and air $C^2 R$ losses in shunt field, series field, rheostat, and German silver shunt. The methods employed in determining these various losses will not be considered beyond saying that they were sufficiently accurate for the purpose. Referring to Fig. 2 it will be noticed that friction is practically constant for all loads, as shown by E. Core losses, curve C, increase rather slowly, but it will be noticed that this is one of the large losses. $C^2 R$ loss in the shunt field or that due to the current in, and resistance of conductor is small, as shown by curve F, since this current is always small. This is also practically constant, as is likewise the loss due to the rheostat in series with this field, curve H. The $C^2 R$ curve loss in the series field, curve G increases with the output, but is always small. Coming to the armature $C^2 R$ losses, curve D, a rapid increase will be noticed as the load on the machine is increased. Curve B is the sum of these various losses and the marked effect of D and C is shown by its increasing curvature. From no load to about half load the total loss increases about one-third as fast as the output, while from half load to half overload the total loss increases directly as the load.

As already explained, these curves obtained only for a 325 K-W. generator, but the percentage of loss to output may be used over a wide range. If we, therefore, determine what per cent of total loss each component loss is, we may employ these figures in any general consideration of larger machines. The total loss at full load or 325 K-W. is 19.6 K-W. or 5.8% of the full load output. This figure of 19.6 K-W. is made up as follows:

	Per cent.
Core loss	41
$C^2 R$ in armature	30½
$C^2 R$ in shunt field	6
$C^2 R$ in series field	2¾
$C^2 R$ in rheostat	1¾
Friction	19
Total loss 19.6 K-W. equals	100

A study of the data presented graphically in Figs. 1 and 2 would seem to indicate that this type of generator had, during the brief period of electric railway work, scarcely more than 10 years in length, reached a stage where radical departures must be introduced before an increased efficiency, reduced weight, or much of an improvement in operation can be expected. It would further appear that about 2,000 K-W. may be regarded as the limiting output of such machines, it being evident from the curves, as is found in practice, more economical to put in more machines operating at a maximum efficiency to be shut down or started up according to the demands of the system.

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The need for a deeper channel at the entrance to the port of New York is engaging the attention of those interested in maintaining the commercial supremacy of that city. The present channel depth is 30 ft. at mean low water, as completed in 1890, and deepened from 24 ft. under the provisions of the River and Harbor Act of July 5, 1884. In the past dozen years, however, the size and draft of steamships have been rapidly increasing. In 1885 there were only eight steamers coming to this port drawing 27 feet. and over, and the greatest draft was 27 ft. 3 ins.; in 1890, the number had increased to 28 steamers of a draft of 27 to 28 ft., with a maximum of 28 ft. 4 ins.; in 1896, there were 33 steamships entering the port with maximum drafts ranging from 27 to 28 ft., 16 drawing between 28 and 29 ft., and 9 with a draft of 29 ft. and over, with a maximum of 30 ft. 6 ins. When the list of hugh steamships now being built abroad is examined, the urgent need for a greater channel depth becomes apparent. The White Star line is building the "Oceanic," with a tonnage of 17,000 tons, a length over all of 704 ft., and an estimated draft of 32 ft., and the "Cymbric," now under construction by the same company, will rate at 12,000 tons, or about 950 tons less than the Cunard steamers "Lucania" and "Campania," now entering this port on a maximum draft of 29 ft. 2 ins. The Hamburg-American Line has five steamships under construction, which, like the "Pennsylvania," put iuto service by the same company this year, will draw 32 ft. of water with their maximum load. The largest ship afloat at the present time is the "Kaiser Wilhelm der Grosse," of 14,000 tons, with a length of 625 ft., and a maximum draft of 28 ft. 3 ins. These figures are sufficient to show that in the very near future the danger line of a 30-ft. channel will have been passed.

As to the prospects for improvement, we have the Act of June 3, 1897, directing that surveys and estimates be made for a 35-ft. channel in the harbor of New York. And the engineer officer detailed for this work has reported that, if the work is done by the government, a channel 35 ft. deep and 1,000 ft. wide, the width of the present channel, can be made for $1,740,000; the same depth for a width of 1,500 ft. would cost $2,772,000, and a 35-ft. channel, 2,000 ft. wide, would cost $4,180,000. The report is accompanied by the remark that if this work be done by contract, with the allowance of a fair return to the contractor for capital invested, these estimates would be increased 20%. During the fiscal year 1896-97, over 37% in value of all the exports from the United States were shipped from the port of New York, and nearly 63% of all the imports, in value, were entered at the same port. The sum needed for the improved channel is insignificant when compared with the $391,679,907 of exports, and the $480,603,580 in value of imports, recorded for this port during one fiscal year. The proposed depth of 35 ft. for a steamer drawing 32 ft., leaves only 3 ft. of water under the keel, and is certainly none too deep when the possibilities of variations in winds, tides, inequalities of loading and the settling of the vessel in the water when under way are considered.

A new illustration of the valuable labors performed by our consular service is an elaborate series of reports upon the use of dogs as draft animals, a subject upon which Americans have hitherto been deplorably ignorant. Very likely they would have remained in ignorance so far as the consuls were concerned, had not some unknown genius in the State Department discovered that this topic was one demanding investigation, and issued instructions to the American consuls in half a dozen European countries to undertake the work. Their reports occupy 25 pages in the December number of "Consular Reports," and we refer to that document any one who may be contemplating the use of dog traction. The consuls discuss with becoming gravity the various subjects of breed, cost, training, strength, harness, etc., and one of them reports under the first-named head the following interview with a dog dealer in the vicinity of Antwerp:

> The breed? Oh, mon Dieu, I can't tell you much about the breed; the breed makes no difference. What you want is a strong, well-trained dog, and that's what mine are. However, I may tell you that my six dogs are all from the same father and mother. The father is, if I remember correctly, one-fourth Belgian, two-fourths Danish, and three-fourths Scotch, and the mother is, I think, three-fourths Belgian and one-fourth English.

We notice that the instructions from Washington to investigate "dog-draft" were dated March 10, 1897; but whether the credit for starting this inquiry is due to the old or the new administration is nowhere writ down.

PLANS FOR EXTENDING TRANSPORTATION FACILITIES IN AND ABOUT NEW YORK—NORTH RIVER TRANSIT.

We reviewed last week the various projects for increasing transit facilities from Manhattan Island across the East River, and showed that in the near future several improved avenues of cummunication will almost certainly be opened. When we turn to schemes for crossing the North or Hudson River, however, we find no existing means of communication save by boats and no immediate prospect—to say the least—of the construction of either bridges or tunnels.

As most of the readers of Engineering News will recall, however, there are now before the public two projects for crossing the North River by single span bridges, and there is also at least a possibility that the old Hudson River Tunnel scheme may be revived. These bridges are being promoted by separate and rival companies, and the plan of each of these companies is to provide a thoroughfare which can, and it is anticipated, will, be used with equal rights by all railway companies desiring to cross the river, and, in conjunction with these railways, to develop such approaches and connections as are necessary to make this thoroughfare accessible from both sides of the river. The prospects for construction and the future development of both plans, therefore, depend largely upon the active co-operation of the railway companies entering New York city. The significance of this dependence will become more clear as we proceed.

The North River Bridge Co.

The older of the two bridge projects is the one known as the North River Bridge, proposed by a company of the same name, but which is, perhaps, more familiar to engineers as the plan devised and advocated by Mr. Gustav Lindenthal, M. Am. Soc. C. E. The North River Bridge Co. refuses any information as to its present plans, but according to information gathered in the past this bridge would cross the North River in the vicinity of 23d St., with a suspension span of 3,100 ft., and would be designed for no less than 14 railway tracks. It was proposed to build only eight tracks at first, leaving the other six tracks to be added as the traffic demands. Of these eight tracks two would be for local electric cars, two for suburban trains, two for express trains and two for freight trains. The length of the bridge proper was to be 7,340 ft. One or more elevated approaches on the New Jersey side of the river were to connect the bridge with the railways entering Jersey City and Hoboken from the west. On the New York side a similar approach was planned to run north to connect with the freight terminals of the New York Central & Hudson River R. R., on the North River water front. In connection with these approaches terminals and connections were proposed for elevated and surface railways at both ends of the bridge.

So far as the public has been made aware, no definite traffic arrangements have been made with any of the railway companies, nor have any of the railways signified their willingness to co-operate even in the construction of the necessary connections and terminals. The promoters of the bridge decline to make any statement regarding these matters, or in respect to the financial prospects of the project in its entirety, except to say that the work of promotion is all the time being pushed, and that they are fully convinced that a traffic can be secured which will make the bridge pay from the beginning. The bridge proper, with eight tracks, is estimated to cost $21,000,000, and $15,000,000 will, it is estimated, be required for real estate, terminal structures, etc.

The New York & New Jersey Bridge Co.

Like the promoters of the North River Bridge, the rival New York & New Jersey Bridge Co. declines to make public its financial prospects, but asserts that the work of interesting capital is constantly being advanced. This bridge, according to the company's latest prospectus, would cross the North River near 59th St., in New York, with a single span carrying six tracks. On the New Jersey side of the river it is proposed to run one approach north and another south, the two thus intersecting all the principal lines terminating on the west side of the river. On the New York side one elevated approach is planned to run south and east to a high level terminal station fronting on Broadway, between 49th and 51st streets, and one is planned to run south along the Hudson River water front for the whole length of Manhattan Island. The bridge with its approaches and terminal station is estimated to cost $65,000,000.

Regarding the matter of securing traffic this company is, if anything, more hopeful than its rival. Its latest estimate is that it will secure 30 per cent. of the local passenger traffic, 60 per cent. of the railway passenger traffic, and 50 per cent. of all the freight traffic crossing the North River. The North River Bridge, on the other hand, will, it is estimated by its promoters, command 40 per cent. of the total railway and local passenger traffic, the greater part of the perishable and high-class freight traffic to New York city, and practically all of the through freight to and from New England.

The present condition of the two North River bridge projects may, therefore, be summed up briefly as follows: (1) Engineering plans and estimates have been prepared in some detail, and the costs of the bridges and their terminals more or less closely determined; (2) Propositions have been made to the various railway companies tributary to the bridge to allow connections to be made with their lines and to use the bridge for their traffic, but, so far as is known, no definite contracts have thus far been secured; (3) Work is now in more or less active progress to secure the co-operation of the railways and to satisfy investors that good interest can be earned on the capital required for construction.

The Hudson River Tunnel.

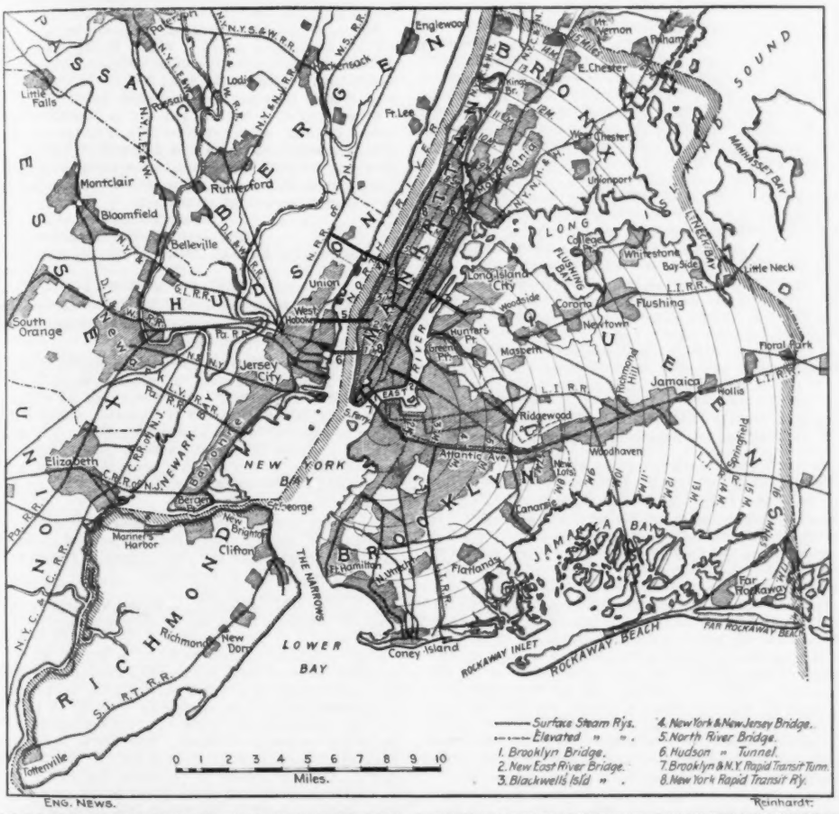
As we noted above, there have recently been rumors concerning the renewal of work on this enterprise. Very little definite and reliable information can be secured; but Mr. Simon Sterne, of

New York, N. Y., the attorney for some of the English interests connected with the project, is quoted as authority for the statement that English capitalists have pledged $1,000,000 to carry on the work, and that construction will be resumed.

Continual bad luck has dogged this project from the beginning. Work was begun in 1874, but only a few feet of the first shaft had been sunk when litigation stopped all further construction until 1879. Lack of money stopped the work in 1882 for a period of six years. By 1889 more money had been raised and work was pushed energetically until July, 1891, when it had to be stopped a second time for want of money. Since 1891 no work has been done, and the tunnel and shafts have filled with water. At the time work was stopped last about $2,500,000 had been spent in construction. As will be remembered by many of our readers, the original plan of the work contemplated two tunnels, side by side, each carrying a single line of railway track. Practically all the work thus far has been done on the north line of tunnel, of which about 4,000 ft. have been completed. This leaves to be constructed about 1,600 ft. of the north tunnel, practically the whole of the south tunnel, and the approaches on both sides of the river for both tunnels. Of course, the additional $1,000,000 stated to have been raised in England will not be nearly enough to complete the work as projected. It may prove sufficient, however, to finish the single line of tunnel and its approaches, upon which the most work has been done, and as a matter of fact, it has been tacitly understood for some years that the promoters who have sunk their money in the project have been working on the basis of completing the north tunnel alone and depending upon it to recoup them in part, at least, for their previous losses. Without attempting to discuss at all the financial and engineering difficulties involved in this enterprise, it is evident that even if a single track railway tunnel were completed beneath the North River its traffic capacity would be so trifling that it would cut a very small figure in the problem of extending transportation facilities between New York and New Jersey.

What now is the cause why these three enterprises, all of which have been before the public for many years, have failed to secure the necessary capital for their work? It appears to us, as the result of considerable study of all the conditions of the problem, that the cause in each case is that the enterprise as planned could not secure sufficient traffic to pay the interest on the capital it would require.

To the merely casual student of the problem, this may appear a strange conclusion. Here is a city of over three millions, along whose westward border flows a broad and deep river. Nine-tenths of the trade and traffic of the city flows to and from the West, and it would seem at first sight that a bridge which would obviate the transfer by boat across the river would have an almost unlimited volume of traffic to draw upon and could not fail to be a financial success. But conclusions based on such sweeping generalities are often unsafe. Let us briefly analyze the different classes of traffic which now cross the North River, and see what proportion of each a bridge might hope to command.



MAP OF GREATER NEW YORK AND ADJACENT NEW JERSEY COUNTIES SHOWING LOCATION OF PROPOSED BRIDGES AND TUNNELS ACROSS THE EAST AND NORTH RIVERS.

First let us consider the freight traffic between New York and the railways terminating on the New Jersey side of the North River. At present this is carried on almost entirely by "car floats." These are barges carrying a double line of railway tracks on their deck, built substantially, but of the simplest and cheapest construction. They are handled by small tugs, and a single float generally carries eight or ten cars. If the reader will examine the accompanying map of New York city, or, better still, a map on a larger scale, he will see that each of the railways on the New Jersey side of the North River has its own extensive system of terminals and yards. Some of them are located in Hoboken and Jersey City, but many of them are farther to the west, on the Hackensack meadows, where land is cheaper and the network of tracks necessary can be installed at smaller cost. In these yards is performed the work of sorting the train loads of freight brought in from the west, and arranging it according to its destination. When this sorting is done, the cars are pushed out on the docks, rolled across a transfer bridge onto the car float, and a few minutes later are hauled off the float at their destination on the other side of the river. The point we wish to emphasize is that this process of distributing freight is vastly cheaper than the distribution that would have to be made if freight were brought across a bridge onto Manhattan Island, and were delivered at a single terminal there. Even with all that could be done in the way of sorting cars before their transit across such a bridge, it would take so vast a system of switching tracks, to separate them at the New York end and direct them to their various destinations, that it is doubtful whether permission of the city authorities could ever be obtained for the erection of the structures that would be necessary. The fact is that instead of the North River being a barrier to traffic under present conditions, it is really a vast distributing yard with its tracks always maintained free of cost, and in which a train can move from one point to any other without obstruction or delay.

Nor is this yard limited in extent to the North River. The car float goes from the Jersey City pier to any point on the East River, the Harlem River, or the harbor, and by reason of this enormous mileage of water front the loaded freight car can be delivered at a warehouse close to its final destination at less total actual cost than the switching charges for similar transfer in any other great city of the country. Space does not permit a full presentation of this question It can only be said that the more study one gives, the more fully convinced must he be that a bridge across the North River could not hope to secure freight traffic of any amount.

It is often said that the through freight to New England from the west would seek such a bridge; but here again the expense of switching comes into play. A train starting from, let us say, the Pennsylvania yards, would have to traverse a maze of passenger tracks to reach the bridge, and when across it would have to reach through other crowded yards the Hudson River freight line of the New York Central, and then traverse some 16 to 25 miles of very crowded tracks and yards before it would be on the open road of the New York, New Haven & Hartford. It seems evident that such a route cannot be a cheap one for freight transfer, even if the amount of the bridge toll be left out of consideration.

Another idea that has secured much hold on the popular imagination is that a bridge across the North River would mean the transfer of through passenger traffic to a great terminal station on Manhattan Island, the traveler en route for Chicago would get into a Pullman car somewhere in the vicinity of Broadway, and go without change to his destination. There is something to be said for this scheme; but we must seriously question whether it is likely to be realized. To accommodate the through passenger traffic of the railways terminating on the west side of the North River would require a trainshed considerably larger, probably, than the Pennsylvania's present Jersey City station, and it would cost a pretty penny to put such a building down in the center of Manhattan Island. If all the roads used it, there would be no material gain in traffic to them, and no one could afford to use it alone.

The fact is, there is one class of traffic and only one, which a bridge across the North River can secure, and for that class of traffic a bridge is urgently demanded. That traffic is the same class that crowds the Brooklyn bridge to nearly the limit of its capacity. It is the thousands of commuters or suburban residents who every morning and night have to cross the river on their way to and from business. The volume of this traffic is enormous; it is increasing at a rapid rate; and were a bridge available for its use it would grow still more rapidly.

At present the army of commuters who daily go back and forth from New York to the suburban towns on the lines of the Erie, Lackawanna, Pennsylvania, New Jersey Central and West Shore railways, takes a journey whose average

duration may be placed at one hour, and not less than half of this elapses between the time the train stops in Jersey City station and the time the passenger reaches his place of business. In other words, the mile from the Jersey City station to a commuter's office in New York takes him as much time to cover it as the 5 to 15 miles from Jersey City to his suburban home. Clearly if any engineering work can save an hour a day to fifty thousand or a hundred thousand business men, its financial returns should not be doubtful.

Unfortunately, as it seems to us, the promoters of both the projected North River Bridges have failed to appreciate the fact that it is the suburban traffic, and practically that alone, on which their structures must depend for income. Probably four-fifths of those who daily cross the North River have their places of business below Canal St. Yet one of these proposed bridges is located at 23d St., two miles up the river from the destination of most suburban dwellers, and the other is near 60th St., some four miles north of where a bridge ought to be to accommodate this traffic.

But the objection will, of course, be raised that the river widens so much when we go below the site selected by the North River Bridge Co. as to increase greatly the span and the cost of the structure, and to make the enterprise financially impossible. This is possibly true, if it is assumed that the bridge must of necessity be made with a single span; but we are unable to perceive that this is a necessity, even though we are aware that the maritime interests have in times past strongly opposed the proposition to place a pier in the North River; and have secured in their aid many of the principal commercial organizations of the city.

The late George B. Roberts, President of the Pennsylvania R. R., is reported to have once said, "When the people of New York get over their sentiment against a pier in the North River they will get a bridge across it; but they never will before." We would hardly put the case so boldly as that. This much, however, seems to us certain: That no bridge across the North River can be a financial success unless it is so located as to compete with the present ferry system in transferring passengers to the downtown business district of New York.

LETTERS TO THE EDITOR.

In which the American Eagle is not Allowed to Scream—very much.

Sir: You received a hurried letter from me written at Bonn-on-the-Rhine (Eng. News, Nov. 18). Since then I have sampled the several and many styles of railway travel open to the unfortunate European traveler, and still live. Railway travel is still as of old, distinctly worse on the Continent than in the United States, and a shade more uncomfortable in England than on the Continent. This is said from the standpoint of one who has tried all that money will purchase over here—first-class ticket in "D" trains, and all other d—— supplements, and d—— two-for-a-cent extras by means of which the traveler is bled as he goes along. No use! The sum total is still mighty poor.

From Bonn I went on a tour through mechanical and hydraulic Switzerland, and again to Berlin, and to London. Switzerland, as might be expected, is showing great energy in the utilization, by means of the electrical transmission of power, of its water power. They call their water falls their mines of white coal, and are not slow in exploiting inexhaustible coal mines of that sort, especially as they have no coal mines of their own. The city of Geneva, which years ago built a high-pressure hydraulic distribution of power plant, has since built another, an electrical central power station, is preparing to build a third next year, and has a fourth one in prospect. Eventually the city is to own, in this manner, four water powers, capable of distribution to its citizens and aggregating some 75,000 HP. The city has even invaded and peaceably annexed French territory. By agreement with the French government a neutral zone has been created in France, contiguous to the Canton of Geneva, in which Geneva may sell power, and upon which manufacturing may be carried on without French let or hindrance.

In the designing of turbines the Swiss and Germans are showing marvelous skill, and a liberty of action, that is freedom from precedent, that would not have been thought practicable 25 years ago. The great point of difference between Swiss and German turbines, and turbines built in the United States, is that the former build their wheels to have the same number of revolutions as the main shaft, so that these wheels may be directly connected with whatever machine they are to drive, while American turbines are still turned out in lots, and must be geared up or down, in order that they may properly drive the dynamo, or pump, which is to be driven. This last means extra shafts, gear-wheels and similar paraphernalia, taking up room and contributing in a painful degree to wear and to break-downs, and to consequent cost of maintenance and operation.

At Rheinfelden I saw a large new power plant in process of construction to be completed in a few months. Each unit was of 1,200 HP., consisting of a dynamo and two turbines on the same vertical shaft. Each turbine was in four tiers, or four stories high. The two lower stories of the upper turbine and the two upper stories of the lower turbine had a joint discharge channel, while the two upper stories of the upper turbine and the two lower stories of the lower turbine had each a discharge channel separate from the other two channels of discharge.

The resultant unit is compact, durable, devoid of any gearing, and I doubt not will prove to have an excellent mechanical efficiency.

Moral. To drive pumps and dynamos the water-motor should have the number of strokes or revolutions per minute that constitutes the normal play of the pump or dynamo to be driven.

As another illustration of this fundamental principle of plant design, I saw in Berlin the shop drawings of a pump of 1½ million gallons per 24 hours capacity, and 1,200 ft. lift, which is to make 500 strokes per minute, being connected directly to the shaft of a cheap dynamo, and by cheap dynamo I mean one designed for high rotative speed. It is needless to say that the designer of this oscillating plunger pump was Prof. A. Riedler. At the rate this skillful designer is going, he will soon be able to furnish pumps of any desired capacity and speed, no less than a motor of any desired speed and power.

Zurich is using American pig iron. England is buying American I-beams and other steel and iron, even cast-iron pipe. How, indeed, can Europe compete with people who load iron ore from the mine, or open cutting, into the cars with a steam-shovel, where Pennsylvania has found that it cannot compete with them? This much is settled; we shall supply the world's needs in iron and steel for some little time at least.

Yours very truly, "2 Wall St."

London, Nov. 10, 1897.

Proposed Storage Reservoir and Infiltration Conduit for the Water Supply of Columbus, O.

Sir: Enclosed I send you clippings from the Columbus "Evening Press" of Nov. 10, 1897, which gives an address by DeWitt C. Jones, editor of that paper, on the waterworks in this city. Present at this meeting was the State Board of Health of Ohio, whose report on filtration at Lorain you quoted from in your issue of Nov. 4, expressing approbation of the course pursued by the board in matters pertaining to water supply and sewerage.

This address by Mr. Jones illustrates the situation at this point. You will note by the arguments used that the State Board of Health of Ohio has a big job on its hands to educate the public when the editor of as large a newspaper as the "Press" has such crude ideas as he here expresses. You will further realize the poor plans adopted by the city, when I inform you that the provision is to take water from the Scioto River, which drains an area of about 1,000 square miles, has three good sized towns on its drainage area and a great deal of sewage pouring into it.

The city plans consist of a storage dam 30 ft. high to impound 1,500,000,000 gallons. The water is to run down the bed of the river two miles, where it is proposed to place a 42-in. cast-iron gathering conduit 16 ft. beneath the bed of the river, the conduit to be about 1¾ miles long. The shell of the pipe is to be ¾-in. in thickness, and each length is to have 48 holes, 2½ ins. in diameter on its under surface. The idea is to allow the water to percolate down through the gravel in the bed of the river to the conduit. The city authorities believe that this is all the filtration that the water needs, and that they will have taking water from the river, which already contains about 20 parts per 100,000 of permanent hardness, and passing it through a gravel bed, which will increase the hardness to about 50 parts per 100,000.

In my opinion, the most feasible plan is to construct a dam 60 ft. high, put in water wheels, pump the water to the top of a ridge 12 miles from the city, and bring it down through a canal to a point about four miles from the city, and thence through a pipe line to the city, passing the water through subsidence basins and adding sufficient lime to reduce its temporary hardness from 50 parts to 10 parts per 100,000. This plan also includes natural filter beds or a mechanical filtration plant. It would reduce the hardness of the water to that of lake water, and remove all germs of disease.

The city plans would increase the hardness 25 times and in my opinion would fail to remove the bacteria. In fact, I believe that within a year the bed of gravel would become saturated with a filthy sediment from the river, and the water in the conduit be worse than the water in the river.

The city's proposed conduit will cost about $60,000, its dam, including all flowage rights, about $240,000, making a total cost of about $300,000. Our proposed plan, including filter beds, will probably cost $1,000,000, but we save the cost of pumping the water, $40,000 annually, which pays the interest at 4% on the cost.

The more enlightened citizens of this town have asked for an expert. The Board of Public Works is opposed to having an expert solve the water question. The editor of the "Press," being of the same politics as the board, in this address attempts to defend their action.

I also enclose a circular put out in opposition to the issue of bonds. At the election Nov. 2 the proposition to issue bonds to construct a dam and conduit after the city plan was defeated. The board is now trying to get public sentiment in its favor so as to have a special election in order to put its plan into execution.

Yours truly,

John J. Dun, Consulting Engineer.

Columbus, O., Nov. 11, 1897.

(In accordance with our custom, proofs of Mr. Dun's letter were submitted to Messrs. Griggs and Jones. A reply has been received from Mr. Griggs, which we give below.—Ed.)

Sir: With reference to the communication from Mr. John J. Dun, of Columbus, O., proof of which has been submitted to the writer, I would say that the daily consumption of water in the city of Columbus, O., for a population of about 130,000 is 15,000,000 gallons. The greater part of the year this is all supplied from under ground sources, but in the dry season it needs to be supplemented by about 2,000,000 gallons daily, drawn direct from the rivers.

The flood flow of the Scioto River is approximately 40,000 cu. ft. per sec. from a drainage area of about 1,000 sq. miles. Gagings by the State Board of Health in the present year showed at Columbus:

Columbus, O., Nov. 18, 1897.

Aug. 5....	97.00 cu. ft. per sec. =	62,660,000 galls. in 24 hrs.
Sept. 17..	4.51 cu. ft. per sec. =	2,910,000 galls. in 24 hrs.
Oct. 1....		1,310,000 galls. in 24 hrs.

If the proposed conduit, 8,500 ft. in length, 42 ins. in diameter, with 48 holes 2½ ins. in diameter every 12 ft., laid continuously in a water bearing gravel, will furnish the desired supply. An experience of about 20 years by the city would seem to prove that the underground supply is not dangerous to health. The city is now drawing a supply of about 7,000,000 gallons daily from a brick conduit or filtering gallery of the same diameter 9,281 ft. in length, of which the above would be an extension. A large store of water in the valley just above the conduit would feed the water bearing gravel by a system of natural filtration. Should the expectation as to quantity prove on trial deficient, it would not be a difficult matter to add a filtration plant to the plan and purify the raw water taken in from the river.

The water of this whole section flows over and through limestone formations of rock, gravel, and clay, and, as a consequence, is impregnated with minerals which render it hard, as the analyses given herewith will show:

(Grains per U. S. gallon.)

Location.	Solid matter.	Material, scale—Soft.	Material, scale—Hard.	Material, scale—Cor.[2]	Composition of scale—Soft.—Carbonate Lime	Composition of scale—Soft.—Carbonate Magnesia	Composition of scale—Hard—Sulphate of Lime	Composition of scale—Hard—Sulphate of Magnesia	Composition of scale—Hard—Sulphate of Alumnum	Composition of scale—Phosphate of Lime	Silicon.
Canal water, Circleville, 30 miles s. of Columbus*	18.56	10.12	5.18	2.58	9.88	0.24	5.02	0.10	....	trace	0.06
City water supply of Circleville†	21.12	16.02	2.23	trace	15.20	.56	2.20	trace	.....	trace	....
Alum Creek at east edge of Columbus	16.58	5.10	9.23	trace	4.70	.40	7.18	.23	1.56	trace[1]	trace
6-in. driven well, 77 ft. deep; C., S. & H. Ry. shops.	14.23	9.18	4.18	trace	7.12	2.00	4.00	.13	trace	trace[1]	....
City water at Columbus.	17.93	10.58	6.12	trace	10.58	...	5.72	.28	.10	trace[1]	.....

* Derived from the Scioto and tributary streams. † Derived from limestone gravel by filtering gallery. [1]A trace of phosphate of magnesia was also found at these three points. [2]Corrosive scale is probably from the manufacturing waste turned into the river at Columbus.

accomplished their purpose of providing a pure water supply for Columbus when this is done.

These plans have been drawn by the city engineer. Not a single expert of any kind has ever examined or approved them. In my opinion the plans would result in complete failure, for the reason that they provide for

There is nothing in these figures to indicate a gain of 2½ times of solid material by flowing through the gravel into the conduit as apprehended.

The plan proposed by Mr. Dun suggests a question for expert knowledge and experience. What height of dam could be safely constructed on a porous limestone founda-

tion so that the losses through subterranean channels induced by the head shall balance the gains of increased storage in the upper level of the reservoir. The streams in this section flow in shallow valleys between broad, fertile ridges, which approximate in height about 150 ft. above the bed of the streams. The readers can judge of the value of the gravity supply derived from the canal on the plan proposed by Mr. Dun. Columbus itself is for the most part located on such a ridge.

The vote on the bond issue for the proposed storage dam at the November election was as follows:

For the bonds	13,211
Against the bonds	7,276
With no choice	4,138
Total	24,625

For your information enclosed find a copy of a card issued by the Board of Public Works in answer to the "circular put out in opposition to the issue of bonds:" I would further say that the private interest seeking to furnish the city with water has made no surveys of its own, but has sought the privilege of photographing the maps made by the city in furtherance of its own private ends, a request which was very properly refused.

Respectfully, Julian Griggs,
Chief Engr. Dept. Pub. Improvements.

(The campaign documents accompanying the above letters indicate clearly that some of the citizens of Columbus are endeavoring to secure a contract to develop a water supply for the city, and that the Board of Public Works is trying to prevent such a solution of the water supply question.—Ed.)

The Disposal of Garbage and Refuse.

Sir: In your editorial in your issue of Nov. 11 on "The Unsatisfactory Condition of Garbage Disposal in America," you refer to the lack of engineering investigation into this important subject and assign as a reason therefor that the development up to this time has been accomplished mostly by small capitalists and inventors whose aims have been more to invent and sell than to develop a scientific principle. This is very true; it must not be forgotten, however, that we have few large cities in this country where it has not been possible heretofore to haul the refuse to a tipping place in an uninhabited district where no great nuisance would result from such a practice. When cities grow to large proportions the high values of land in the suburbs and the long haul necessary to find a suitable tipping place make necessary some other solution more economical and more satisfactory from a sanitary standpoint. This condition has yet been reached by but few of our cities, but the time is at hand when the importance of the question will demand that it receive more attention than has yet been bestowed upon it.

England, with her thickly settled farming districts surrounding the large manufacturing towns, has been the first to face this problem and to attempt to solve it in a scientific manner. Their efforts, extending over many years, have been attended with numerous failures, each of which marks a step in advance. The results they have attained are before us and we should not lightly put them aside. The confirmation of these results by the experiences of Berlin and Hamburg add still further evidence to the security of the foundations laid by the English practice. There is still undoubtedly much to be learned as to details of construction of the proper furnace for the combustion of refuse, and it may still further be said that probably no one fixed type of furnace will be suited for the combustion of all kinds of refuse without considerable modifications. Neither can it be said that there is no way to combine some utilization process with that of combustion whereby the cost of disposal may be reduced to a lower figure than has been attained by combustion or utilization alone. The field is fertile and offers considerable possibilities. This combination is in the experimental stage at Colombes, France, under the direction of the engineers of that city and gives promise of good results. The process, in brief, consists of absorbtion of the distilled ammoniacal vapor from the garbage by the hot gases from the combustion of the refuse after they have been deprived of their oxygen. These gases are subsequently passed through acidulated water where the ammonia is dissolved, thus recovering from the refuse the fertilizing element. The figures of cost given by the authorities show a considerable profit in the process and the method is said to be very satisfactory.

Whether the demand for fertilizer in this country would be great enough for such a process to be applicable to our conditions cannot be foretold without an investigation, but it is a suggestion of a radically different method from the English practice where everything is burned up and from the various reduction processes such as are used quite extensively in this country.

Your exceptions to Mr. Hering's statement that utilization or reduction plants should be looked upon with suspicion, excepting under certain conditions, should be qualified to the extent of stating that the different kinds of plants should be operated upon the same basis in order that one may be as free from nuisance as the other. In this country the rule is that the reduction plants are run by companies who seek to make a profit from them, while destructor plants are owned and operated by the municipalities whose first aim is to prevent a nuisance. Were the reduction plants so owned and operated it might be that one system could be as nuisance-free as the other.

The city of Manchester, England, for instance, operates an enormous plant for the utilization of the city refuse, making soap, axle grease, engine oil, disinfecting powder, fish guano, phosphates and fertilizers. The works are operated by the Cleansing Department of the city and are kept very clean and inoffensive by the free use of disinfectants, the only disagreeable odor about the place being where the fertilizer is stored.

Destructor plants, faultily designed and carelessly operated, also produce nuisances, but there are numerous places where intelligence has been used in the design and operation of the furnaces, where no complaints have been made against the process.

Regarding the separation of the ashes from the garbage and other refuse at the houses so far as the cremation process is concerned, it is unnecessary. The fine dust and ashes may be separated from the other matter at the works by simple screening at practically no additional expense. This is done at both Manchester and Glasgow, and at several of the works near London. The fine dust thus screened out will undoubtedly contain some of the finer organic matter of the refuse, but the proportion is so small that it may safely be used for filling purposes.

As a short summary of a considerable amount of data gathered from many towns and cities, the following items regarding refuse destructors indicate fairly well the English practice and the results that have been attained. One cell or furnace is generally provided for about 8,000 people, varying from 3,000 to 20,000, according to local conditions.

The usual grate area provided is about 25 sq. ft. to each cell. The average cost is about $2,000 per cell in moderately small plants, decreasing to about $1,000 per cell in large ones.

A fair and attainable consumption of unscreened refuse is 7 to 8 tons per cell per day, when burning at economical rates, and from 10 to 27 tons as a maximum with strong forced draft and very frequent clinkering. At such great rates the cost of burning is very much more per ton than at the lower average rate.

The burned refuse reduces to a hard vitreous clinker of ¼ to ⅓ the weight of the original refuse, which is used in making mortar, concrete, sidewalk paving slabs, for street sanding and road making.

Ordinarily, the steam producing power of the heat from one cell is about 6 to 7 HP. continuously, with thermal storage, varying from 4½ to about 30 HP. In certain plants, especially designed for power development. The steam is used for operating mortar mills, fodder choppers, air compressors and sewage pumping machinery, and as an aid in electric lighting installations. It is also used in steam disinfecting plants and in public laundries and bath houses.

The cost of burning the refuse after its delivery to the destructors is usually about 37 cts. to 50 cts. per ton, but is frequently less than 25 cts. In some cities the sale or use of the products of the combustion will reduce the net cost of burning as low as 15 cts. per ton.

James H. Fuertes.

New York, Nov. 13, 1897.

(The comparative newness of improved means of garbage disposal should be remembered, of course, in considering the reasons why engineers have been employed so rarely in this connection. But this is only one of a number of reasons. Nor should the fact that until recently none of the large cities have taken up the matter be given undue weight. In sewage purification none of our largest cities have yet made a move, but in 12 of the 15 largest cities of the United States garbage disposal plants have actually been built and in ten cities are still in operation, treating practically the whole of the garbage. The fifteenth city in this list is Milwaukee, with a population of 204,000 in 1890. Of the 58 cities having over 50,000 in population in 1890 there are 28 in which, to our own knowledge, either cremation or utilization plants have been built, most of these being still in operation, against only three cities that have established sewage purification plants. The total number of garbage disposal plants in the United States to-day probably exceeds the total number of sewage purification plants, including in each case only plants built for cities and towns, not those for institutions. The population served by sewage purification works is but a small percentage of that served by garbage disposal plants, garbage disposal in this discussion always meaning cremation or utilization. Sewage, like garbage, has been and is still dumped unceremoniously where permitted, yet when improved methods of sewage disposal are carried out engineers are a recognized necessity, and have been from the start. Of course, the two problems have many points of difference, some of which explain why engineers are more generally employed in one than in the other, but after making due allowance for these it is still a notable fact that as yet engineers have been employed but little to solve the garbage disposal problems of American cities, big and little. A change in this respect is highly desirable on both sanitary and financial grounds. It will come, surely, even though slowly.

As to screening at the furnaces doing away with the necessity of separating ashes from garbage at the houses, this possibility does not affect the length of haul, which we raised as one of the objections that might be urged in some localities to burning mixed garbage.—Ed.)

Sir: I am sure that I can speak for the committee* in thanking you for so fully reviewing its report on the Disposal of Garbage and Refuse, in your issue of Nov. 11, and thus aiding it in its effort to have the subject given a more scientific treatment than it has usually received. You will no doubt also allow me a few words to avoid some misapprehension, and to give you a few additional and interesting facts.

Your statement, that I seem to be convinced that "the English type of garbage furnace is an unquestionable success" is but partially true, and might be misunderstood. It has, in our opinion, been much more successful in its results than the American type, but it is still not wholly satisfactory. French and German authorities have, for this very reason, subjected the better English furnaces to a thorough trial and have, indeed, found openings for improvement.

You question our "conclusion that all utilization plants, not remotely located, must be looked on with suspicion." You believe that utilization plants "have been or may easily be" built, in which the arising odors are rendered unobjectionable. Although perhaps literally true, this statement does not exactly represent the case. There is no question that it is possible, although at some expense, to render these effluvia always unobjectionable. But, in every large work of this kind to date, there have been complaints recorded. As yet, a utilization plant has in every case been a private business venture, undertaken for the manufacture and sale of grease and fertilizer. If the odors from the works must be entirely prevented, for the benefit of a community, then the profit is sometimes materially reduced. Consequently, a number of such works, from Providence, R. I., to New Orleans, La., were, after several years operation, abandoned as being unprofitable.

With such fundamentally antagonistic interests between a community and a private business, it seems but a reasonable inference to view with some suspicion any public advantage of works which from personal interest give the sanitary question the second instead of the first place. Yet, this qualification has little or no value, when, as reported, the location of the works is such as to make offensive odors unobjectionable to a community. Then, and where it is a profitable business, the utilization of garbage should not be objected to any more than other rendering works.

On the other hand, cremation works are not run for profit, as a first consideration, but are operated primarily for the purpose of obviating a nuisance. They are, therefore, not subject to the above suspicion. Faulty construction and inefficient operation have, it is true, in many cases caused a nuisance. But such defects are clearly unintentional and can be remedied. They actually do not exist in a number of European works, large and small. There is no mercantile interest to turn the desire for preventing objectionable odors into a desire for making money. In deciding upon the preference, after the sanitary question has been equally well answered in a given case, the financial question is the only one left to govern the decision.

In stating the cost of garbage disposal to a community, for comparison, we must not overlook the cost of disposing of the other parts of the refuse. The house refuse may be classed as: (1) Animal and vegetable matter from kitchens and markets (garbage). (2) Dry combustible matter, as paper, rags, straw, leather, wood, sweepings, etc. (3) Cinders and unburnt coal. (4) Ashes. (5) Glass, stoneware, metal, oyster-shells, etc.

All of this material can be passed through a furnace; between ⅓ and ⅔ of the total quantity will burn up and ¼ to ⅓ will remain as clinkers and ashes. For the production of grease and fertilizer, only the material of the first item has any value. The rest must be either in part brunt, such as the material of the second item, or used for filling purposes.

In order, therefore, to ascertain the economy of the utilization process as against cremation, we must ascertain the cost, and take account of the benefit of remov-

*Committee of the American Public Health Association, see Eng. News, Nov. 4, for report.

ing and disposing not only of the animal and vegetable matter, but also of the remaining materials. This point, although stated, seems to have been insufficiently emphasized in the committee's report. As it has been overlooked in some cities, I take the liberty of again mentioning it here.

Regarding your statement that I would very probably agree with you that the promising results with cremation abroad do not indicate conclusively what results could be expected in the average American city, I desire to add a few remarks. The incombustible matter in the European house refuse, including garbage, is reported as being in: Hamburg, 57%; Berlin, 50%; Paris, 37%; English, average, 33%.

Although no long time averages are available in the United States, it is certain that here the percentage of incombustible matter would be as low as in England, and probably still lower. Whatever increase there may be in the quantity of free water, which is contained in our kitchen garbage, it is probably at least balanced, in most cities, by the increased quantity of wasted fats, wasted coal and combustible general rubbish. In the use and rejection of these materials the American is unquestionably more wasteful than the European. When kitchen garbage is mixed with the dry refuse and ashes, much of the free water is absorbed by the latter and some of it lost by evaporation. To the eye there seems to be no difference, as regards moisture, between the European and American mixed house refuse.

The Montreal house refuse is burned, as in England, without the addition of fuel, and it is done in a furnace, similar to the European, but hardly equal to the best.

Therefore, I believe, that with the same intelligence and care, we, in America, ought to get at least as good results as they have obtained in other countries.

It will, no doubt, be of general interest to your readers to glance at the following statement of the comparative annual cost, including amortization, of certain municipal works and operations in the city of Berlin. Wages are of course less, roughly speaking one-half of those in America; but the comparison has some interest and value.

Cost per Inhabitant per annum.

Collection of house refuse and removal to city limits	$0.22
Cremation of refuse (as proposed)	0.08¾
Street cleaning	0.24
Removal of snow	0.06½
Sewerage and sewage irrigation	1.23
Water supply and filtration	1.11
Gas and electric supply	0.41

Very respectfully,
Rudolph Hering.

Woodbridge Building, New York city, Nov. 12, 1897.

(Unquestionably complaints have been recorded against most or all of the large garbage utilization plants of this country, as Mr. Hering states, but so they have against practically all the garbage crematories and sewage disposal plants, in this country, at least, when located near or in urban districts. No matter how scientifically conducted a sewage filter or a garbage plant may be, people object to having such wastes dumped and treated in their vicinity, even though their own houses and yards may be reeking with filth.

Perhaps if utilization plants were to be conducted by municipalities, instead of by private companies, sanitation might be put first and financial returns second as easily as in the case of sewage farms under municipal ownership. We have often called attention to the necessity of enforcing this rule in all sanitary matters.

In regard to the abandonment of a number of garbage utilization plants as unprofitable, when so conducted as to prevent a nuisance, "from Providence, R. I., to New Orleans, La.," we must call attention to the fact that nearly all the plants which have been abandoned have been largely experimental, and serve as admirable illustrations of the unsatisfactory condition of garbage disposal, by whatever process, in this country, as pointed out in our issue of Nov. 11.

The Providence plant, according to a statement from the builders, published in our issue of Oct. 8, 1896, was an experimental one from start to finish, and no contract ever existed between the builders and the city. At New Orleans the contractors claim gross violation of the garbage disposal contract on the part of householders and the city, in the failure to separate the garbage from other wastes. This was given by the contractors as the main reason for shutting down the disposal works in November, 1895, the other reason being "the low prices obtainable for the product" (see Engineering News, Oct. 8, 1896). Subsequently the contractors refused to remove mixed garbage, the city took up the work of collection and disposal, and the company went into the hands of a receiver, who attempted to get satisfaction in the courts, but the case has not been concluded so far as we have learned.

In our issue of Sept. 16, 1897, we published a letter from Mr. Walter J. Blakely, Secretary of the St. Louis Sanitary Co., in which he urged that the large profits from garbage disposal, commonly held out by promotors, were utterly chimerical, and that any company engaged in the business required a goodly sum from the city in return for handling this class of its wastes. Like the experience with sewage farming in this country, returns from garbage disposal can be expected to do no more than lessen the burden of an important sanitary duty laid upon our municipalities.

The point we wish to emphasize is that, as a matter of pure engineering, the choice between utilization and cremation is largely one of dollars and cents. Plants of either kind are a nuisance if not properly managed, and if located in populated districts will be the subject of complaint whether a nuisance or not. Neither system will pay for itself. If a city finds the net cost of utilization to be less than of cremation, shall it adopt the more expensive method because that may possibly permit it to put up with more sluggardly and inefficient employees, or shall it pursue the methods applied in private business and secure skilled and faithful men to operate the least expensive system? Would not the city government that could not be trusted with a utilization plant be likely to make a failure of burning garbage? Between any two methods the simplest is always to be preferred, other things being equal; but where material difference in cost exists it is sometimes advisable to take some risk to save money. If this risk may be practically eliminated by employing faithful and skilled men, that settles it. In this case we believe the risk might be so eliminated in most cases. Where it can we need only consider the relative cost of the two processes. Where it cannot, the relative risk must also be weighed.

The fact that utilization processes cannot deal with dry combustible matter, ashes and various inorganic substances, certainly should be considered in comparing it with cremation. Unfortunately, as Mr. Hering's report stated, we have practically no information regarding the relative quantities of these materials collected in American cities. We are greatly in need of better records relating to municipal undertakings and a free interchange and study of these records by municipal officers.—Ed.)

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Liability to Subcontractor on Railroad Work.

A subcontractor for railroad work to be completed at a certain time, providing unconditionally for the payment of a certain price, "payment to be made on the 15th of each month, or as soon as said railroad company pays" the contractor, does not make payment by the railroad company a condition precedent to the payment of the subcontractors, but merely defers payment to them for a reasonable time to obtain payment from the railroad company.—Crass v. Sarugge (Sup. Ct., Ala.), 22 Southern Rep. 81.

When Buyer Is Not Liable for Refusing City Bonds.

A buyer of municipal bonds from the city is not liable in damages for refusing to accept them when their marketable value is destroyed or impaired by questions of legality arising from facts shown by, or omissions in the city's own records; and it is immaterial that after his refusal, and after the bonds have been sold by the city to other parties, the State Supreme Court adjudges such bonds to be valid, as the purchaser then has no opportunity to accept them with the benefit of such adjudication.—City of Great Falls v. Theis (U. S. Cir. Ct.), 79 Fed. Rep. 943.

Liability of Gas Company for Leakage.

A gas company, furnishing gas through mains in the public streets, is bound to keep its gas under constant control, and prevent it from escaping into dwelling houses or places of business, and if the gas escapes and causes damage the company is liable for the resulting damage.—Admbruster v. Auburn Gaslight Co., 46 N. Y. Supp. Rep. 158.

Construction of Reservoir for City.

A contract to construct a reservoir for a city, provided that the materials should be furnished and the work performed in "exact accordance with the plan on file with the department of public works and the specifications hereto attached," subject to changes which might be made by the city. At the close of a description of numerous things to be done in the construction of the reservoir and the ornamentation of the grounds, was the statement "and all work necessary to make a complete and perfect reservoir ready for use and to leave the grounds in suitable condition." The court held that the quoted clause did not make it the duty of the contractors to construct a reservoir that would not leak, regardless of whether it should be in exact accordance with the plans and specifications.—Filbert v. Philadelphia (Sup. Ct., Pa.), 38 Atl. Rep. 545.

Right of Citizens to Inspect City Records.

Every citizen of a municipality has the right, on all proper occasions, and under reasonable regulations, to inspect and copy its records, books and documents, and the court will, by writ of mandamus, compel the recognition of such right by the custodian of such records, who should he forbid or prevent such inspection.—Commonwealth v. Walton, 6th Pa. Dist. Rep. 287.

PNEUMATIC MAIL TUBES from the principal New York office buildings to the Post Office may in the future form another feature in the equipment of these large buildings. Already several inquiries have been addressed to the Tubular Dispatch Co., who installed the plant now in operation between the Post Office and the Produce Exchange.

FREE PASSES TO EMPLOYEES and subordinate officers of connecting and other railway lines will be abolished by the Southern Pacific, Southern California and Santa Fe Pacific railway companies after Dec. 1, 1897, in the territory south of Portland, Ore., and west of Ogden, Utah, El Paso, Tex., and Albuquerque and Deming, N. Mex., but a special rate of one-half fare will be granted instead. Exception to this rule will be made only upon autographic requests from the President, Vice-President or General Manager of the connecting lines. Connecting lines are requested to ignore requests for free passes unless similarly signed by the same officers of the roads named.

THE COMPARATIVE COST OF MINE HAULING by electric and mule power is well shown in a pamphlet recently issued by the power and mining department of the General Electric Co. The following table has been prepared from the data contained in this circular:

Case.	Cost, per ton. Mule, cts.	Cost, per ton. Electric, cts.	Difference, cts.	Sav'g due electric hauling, per cent.
1.	7.15	2.79	4.39	61.5
2.	6.58	2.62	3.96	60.5
3.	2.35	1.07	1.28	54.5
4.	2.95	1.27	1.68	58.0
5.	8.79	2.19	6.60	75.0
6.	7.47	2.23	5.26	70.5
7.	10.77	4.56	6.21	57.7
8.	9.10	4.65	4.45	49.0
9.	10.2	2.56	7.64	75.0

PROGRESS ON THE PARIS EXPOSITION of 1900 was recently reported by M. Charles Roux to the French Chamber of Deputies. The provisional railway station at the river end of the Esplanade des Invalides, is depressed, so that it will not interfere with the view of the Invalides, and is now nearly completed. The width of the new bridge of Alexander III., over the Seine, and in front of the Invalides, has been fixed at 40 m., or 134.4 ft.; this surpasses by 32.6 ft. the width of any bridge in Paris and the lowest point of the superstructure will be over one metre above the corresponding point in the bridge de la Concorde, which crosses the Seine just above. The foundations of the new bridge are rapidly approaching completion. The caisson on the right bank is finished and sunk, and the one on the left bank is built and ready for sinking. The old Palais de l'Industrie is being rapidly demolished and parts of the foundations are laid for the new permanent Fine Arts Building. The plans for the administration buildings, upon the Esplanade des Invalides and on the quays, will be completed this winter. Up to July 15 there had been expended for the Exposition 7,479,070 francs, or $1,495,814. The total estimated expenditure for the Exposition is placed at 106,783,506 francs, or $21,356,701, including $557,195 to be spent in 1901 in restoring the grounds to their original condition.

U. S. FOREST RESERVATIONS, according to the late report of Secretary of the Interior Cornelius N. Bliss, now number nineteen, and embrace an estimated area of 18,993,280 acres. These have been set aside, from time to time, by Presidential proclamations; but 13 reservations created by proclamation of Feb. 22, 1897, and containing an estimated area of 19,951,360 acres were suspended by the Sundry Civil Act of June 4, 1897, until March 1, 1898. Inadequate appropriations have prevented Secretary Bliss from re-establishing a Forest Bureau in his department, but he appointed as many special forest agents and supervisors to patrol the reserves and enforce regulations, as circumstances would permit. This force, he says, is inadequate, and he hopes that Congress, in the interest of economy and wise policy, will make such provisions as will enable him to appoint an efficient force of at least 60 men.

SMOKE CONSUMING DEVICES are to be tested under the boilers in the city hall in Kansas City, Mo., according to an ordinance passed by the city council. An appropriation of $1,300 has been made to purchase smoke consumers, after tests have proven them satisfactory. If these tests show that the boilers of the city hall can be made to stop emitting smoke, then the enforcement of the smoke ordinance throughout the city will begin.

THE NEW HOUSE FOR THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

The handsome new house of the American Society of Civil Engineers in New York city, which has been in process of construction for nearly a year, was formally thrown open to the members of the Society on Wednesday of this week, Nov. 24, 1897. In our next issue we shall outline briefly the more interesting of the opening ceremonies, but by many of our readers, who are members of the Society, and whose residences are so far away as to preclude a visit to New York perhaps for years, a brief description of the new house will, we think, be welcomed with even more interest. It will be remembered that a front elevation of the new building, engraved from the architect's drawings, was published in our issue of May 28, 1896, shortly after the design was accepted. The perspective view of the new house which we publish herewith is engraved from a photograph of the completed building and is, therefore, free from any idealism of the architect's drawings. It will be gratifying to the members of the Society, we are sure, to see that the new home for which they have labored so long, is if anything even more pleasing in its exterior than the architect's drawings promised. In its interior the house is fully as commendable for the excellent taste displayed in its fittings and decorations.

The house has four stories and a basement, all of which will be used for the Society's work. Entering the first floor there is a small vestibule which opens into the main hallway extending toward the rear of the building. The floors of the vestibule and hallway are mosaic. To the left of the hallway are a small reception room in front and the coat-room, and to the left are the offices of the Secretary and his assistants. The main hallway terminates in a flight of three steps, extending down to a broad landing approaching the lounging-room, which occupies the entire rear of the building on this floor. This room is furnished with tables for magazines and newspapers, and is lavishly supplied with settees and easy chairs. The furniture and the wood-work here and throughout the building are old English oak, and the walls and ceiling are plaster calsomined in terra cotta effects. A stairway opening off the left hand side of the hallway leads to the second floor, where are located the auditorium and the reading room. The auditorium occupies the rear of the building and has chairs for about 400 people facing the rostrum at the rear end. A stereopticon and various other paraphernalia useful in presenting and illustrating engineering papers are permanent fixtures of this room. The reading room at the front is provided with tables, chairs and desks and with shelves for a limited number of books of reference and of the most frequently-used papers and publications of the Society's library. This room is connected with the book stacks on the fourth floor by an electric book hoist. It will be seen that all of the rooms ordinarily used by the members are on the two first floors which are connected by a broad and easy staircase.

On the third floor are the rooms occupied by the clerical force of the society, and a large front room for the exhibition of models, prints, photographs, etc., of machinery and engineering constructions of all kinds. It is hoped ultimately to develop this room into a permanent society museum. The fourth floor is given up entirely to the book stacks, which are of the adjustable, metal type used in the Congressional Library, at Washington, D. C. These stacks provide shelf room for many years' future growth in the library, and there is room for doubling the present number of stacks should it ever become necessary. In the basement are the janitor's quarters and large storage and publication rooms. In a vault under the sidewalk are two 25-HP. gas engines which drive dynamos that supply electric current for lighting the building.

As was stated in our issue of May 28, 1896, the new building has a frontage of 50 ft. on 57th St. and is 110 ft. deep. The total cost of the building and the ground has been about $200,000. Mr. Cyrus L. W. Eidlitz, of New York, N. Y., was the architect.

THE NEW HOUSE OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS IN NEW YORK CITY.
Cyrus L. W. Eidlitz, Architect.

NOTES ON WATER SUPPLY AND SEWAGE DISPOSAL IN MASSACHUSETTS AND RHODE ISLAND.

(Editorial correspondence.)

(The following notes are based on information obtained during a short trip in Massachusetts and Rhode Island, Nov. 16 to 19. Some of the works mentioned will be described at greater length in later issues.)

Progress on the Metropolitan Water Supply for Boston and Vicinity.

Work is now being pushed at several points, so that water from the Nashua River may be available next spring. The tunnel at the upper end of the line is completed, the aqueduct nearly so, and it is hoped that the open channel below the aqueduct will be done by Feb. 1. Reservoir No. 5 is being filled, but there is still some excavating to be done. With the aqueduct and open channel finished, water from the new source of supply can be delivered into the present reservoir system of the Boston water-works, and thence through the Sudbury aqueduct to the Chestnut Hill reservoir. On Jan. 1, 1898, the commission will take possession of the sources of the Boston water supply and all the main pumping stations. At that time it is expected that the Mystic supply will be cut off from Somerville, Everett and Chelsea. This will be effected by pumping the Sudbury and Nashua River water to Spot Pond, utilizing temporarily the present high service pumps at Chestnut Hill. Next spring the new Allis pump will be put in operation. One of the two 48-in. mains, twelve miles in length, from Spot Pond to the Chestnut Hill pumping station, is now being hurried to completion. About 40 miles of pipe have been laid for the new trunk distribution system, of which about 25 miles is 36 ins. in diameter or larger. The working force is now being reduced, but still numbers 3,100 men, including about 230 engineers and inspectors. Mr. F. P. Stearns, M. Am. Soc. C. E., is Chief Engineer of the commission, and we are indebted to him and to Mr. Dexter Brackett, M. Am. Soc. C. E., Engineer of Distribution, for the above information.

Improvements to the Sewerage and Sewage Disposal Systems of Worcester, Mass.

Good progress is being made in the separation of the sewage of the city from the natural flow of Mill Brook. The sewerage system of Worcester is on the combined system. Its construction was begun long before purification works were planned. For a distance of 3,900 ft. the sewage flows in the channel of Mill Brook, which has been enclosed in a large masonry conduit. A partition wall is being built, and is about half completed, at one side of the conduit, and arched over, to separate the sewage from the brook. It is expected that during the coming year some main sewers will be built for the separation of storm water and sewage, with the idea of ultimately establishing a complete separate system.

The work now in progress in the Mill Brook channel is very unique and interesting. The material for the partition wall and the arch is being handled and the channel is being lighted by electricity. For this purpose a temporary electric power station has been established on the line of the channel, and an inclined railway provided for lowering material to a dock at the edge of the sewer. The cars used on the incline are just large enough to hold 500 brick or sand for two barrels of cement, which simplifies the tally on the quantities of material being used. An electric trolley tow-boat has been provided, built like a catamaran, with a paddle wheel in the center driven by a small motor. Small flat-bottomed scows are used for transporting the material, the mortar being mixed in the scows. Incandescent lamps are suspended from the ceiling at intervals of 3 ft. A fan is provided for ventilation, but there seemed to be little need for it during the visit of the writer.

The coffer dams used consist of 1¾-in. matched plank, placed horizontally, and held in position by means of posts extending to the top of the arch. Rolls of oakum are fastened to the bottom of the coffer-dams by means of burlap, to prevent leakage.

The partition wall is of brick, some 16 or 20 ins. thick, and the arch is of three rings of brick, with about 2 ins. of mortar between the top and middle ring. Tie rods are inserted at frequent intervals to take up the inward thrust of the arch.

At the purification works experiments with sludge presses have been going on for about a year. One large sludge press is now in place and bids fair to give good satisfaction. A bold attempt is being made to press sludge without the use of lime, and present indications are that it will be successful. The press has 125 cells, each making a cake ½-in. thick and 36 ins. in diameter. The press is closed by hydraulic power, the pressure being supplied by a Dean hydraulic pump, which it is calculated will work at 2,500 lbs. per sq. in. The sludge is lifted to a receiving tank by a Deane power pump. It is proposed to maintain a sufficient air pressure in this tank to keep the sludge at or below its center line. When the tank pressure reaches a certain point the engine and pump stop, resuming work again when the pressure falls. The plates of the press slide along the frame on brass rollers, with great ease, so the sludge can be dumped into the car below by one man on each side. Provision is made for draining the central supply chamber that extends through the cells of the press, so that the wet sludge remaining there when pumping ceases need not be lumped into the sludge cars with the dry cakes. The presses are being built by the G. H. Bushnell Co., of Thompsonville, Conn.

All the pressing machinery except the press is being placed on temporary settings for the present, but permanent foundations are being built for four presses of the size given above. The engine and sludge pump will be in duplicate to guard against trouble from accidents. A new sludge tank has been built in the ground between the original settling tanks and the new press house. The sludge is lifted to this by the Shone ejector in use for some time past, and from thence to the

sludge receiving tank and press it is conveyed by the pump described above.

During the past summer large quantities of sludge, perhaps 10,000 loads, have been hauled away from the precipitation works by farmers. It seems to be growing in favor as a fertilizing material. No charge has been made for the sludge, since, with past inadequate means for handling it, the one great object has been to get it removed as speedily as possible, without expense to the city.

The city now owns about 150 acres of land at the works, and expects to build beds next year for filtering the effluent. Experimental filters are now in operation.

The sewage now passes directly through the new tanks, from end to end, instead of passing from one to another, thus decreasing the velocity of flow. To make this possible, a new effluent channel has been formed at the lower end of the tanks, by arching over the lower channel, originally provided to carry a brook and to receive the effluent when the tanks are drawn down for cleaning.

Mr. F. A. McClure is City Engineer of Worcester, and Mr. H. P. Eddy is Superintendent of Sewers. We are indebted to Mr. Eddy for the above information. The Worcester plant, when the improvements now under way are completed, promises to be more full of interest and instruction than ever. It has now for many years been the largest sewage purification works in this country.

Progress on New Sewage Purification Works in Massachusetts and Rhode Island.

At Spencer, Mass., about eight acres' available area of filter beds are now nearly completed. Mr. Nathan Craig, of Spencer, is engineer for this work.

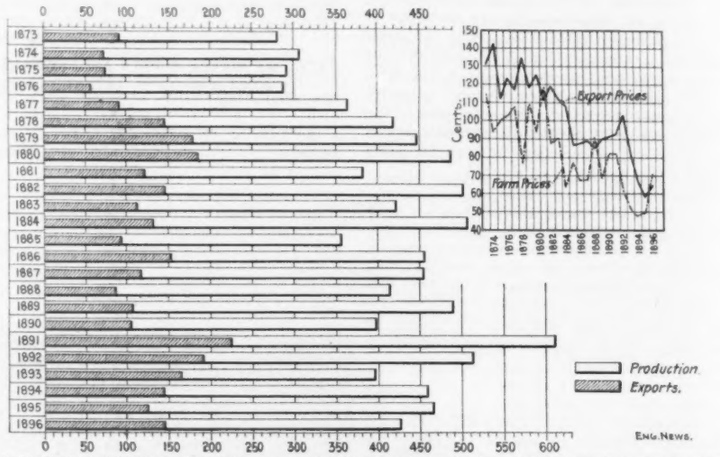
At Leicester, Mass., a town adjoining Spencer, a much-needed addition to the small beds completed not long ago is now being made, but the area seems likely to prove still too small, the material not being well suited to the purpose.

At Woonsocket, R. I., the foundation walls for the new sewage pumping station are up, and the contract has been let for the superstructure; two sewage receiving basins with a capacity of 250,000 gallons each have been completed; and two filter beds with an area of about one acre each are about ready for use, while some work has been done on other beds. The city owns about 50 acres of land on each side of the Blackstone River, some 32 acres of which, not including embankments, will be available for filtration. Eight receiving basins, each of 250,000 gallons capacity, are included in the plans, but it is thought that the two now built will be ample for some time to come. No house connections have yet been made at Woonsocket. It is expected that the sewers will be used next year. Mr. F. H. Mills is City Engineer of Woonsocket.

At Central Falls, R. I., three small filter beds have been in operation for a little over a year. A relatively large settling tank is used in connection with these beds, and a second one is ready to be put in use. The dry weather flow of sewage is only about 20,000 gallons a day, as yet. The sewers here are on the combined system, but as soon as the sewage flow materially increases at times of rainfall it is automatically shut off from the beds. Mr. Wm. F. Keene, Assoc. M. Am. Soc. C. E., is City Engineer of Central Falls.

WHEAT PRODUCTION, EXPORTS AND PRICES FOR 23 YEARS.

In the "Monthly Summary of Finance and Commerce of the United States," issued by the Bureau of Statistics of the Treasury Department, we find a diagram showing the course of wheat production and sales since 1873, which presents so much interesting information in a small space that we have thought it worth reproducing for the benefit of our readers. One fact brought out by the table which will be a surprise to many, is that our average total wheat production, taking good years and bad together, has not increased very much in the past 15 years. The period from 1873 to 1880 witnessed the development of the great wheat growing section of Minnesota and North Dakota, and is chiefly responsible, we presume, for the great increase in production which the diagram shows to have taken place from 1876 to 1880. Since that date great additions to the wheat growing area have been made, such as the lands in eastern Washington, but they cut such a small figure compared with the total production as to be hardly noticeable upon the diagram. The volume of exports is seen to be subject to great variation, but the average appears to be increasing, and could 1897 be added, this would be even more apparent. The diagram of prices reveals one principal reason why production has remained nearly stationary for so long, in the steady lowering of prices which has taken place. The years 1894 and 1895, however, appear to mark a turning point, and could 1897 be added here the diagram would present quite a different appearance.



PRODUCTION, EXPORTS AND PRICES OF WHEAT IN THE UNITED STATES, FROM 1873 TO 1896.

TWO RECENT IMPROVEMENTS IN RAILWAY TRAIN BRAKE CONSTRUCTION.

Recent study of train brake construction has called attention to two possible improvements in brake gear and in brake shoe construction which seem to promise considerable addition to the present efficiency of air brakes on railway trains. The first and more important of these improvements was described by Mr. R. A. Parke, of the Westinghouse Air Brake Co., in a paper read before the New York Railroad Club, on Nov. 18, 1897. Briefly described, it consists in adapting the brake shoe pressure to each truck and to each pair of wheels in a truck exactly in proportion to the pressure of the truck or pair of wheels upon the rail, or, to the friction between the rails and the truck or pair of wheels.

It may be easily shown by a mechanical analysis of the forces acting upon a railway car that when the brakes are applied there is a tendency for the car to rotate upon its forward wheels as a center. The direction of this rotative force is toward the direction in which the car is traveling. This tendency to rotate adds to the pressure on the forward truck, and consequently reduces the pressure on the rear truck; likewise it adds to the pressure on the forward pair of wheels on each truck and decreases the pressure on the rear pair of wheels. In ordinary brake practice the pressure of the brake shoes upon each truck and upon the forward and rear pairs of wheels in each truck is made the same. As this pressure, as is well known, must always be less than that necessary to cause the wheels to slide, and as the brake pressure at which the wheels will slide depends upon the friction between the wheels and the rail it will be seen that the brake pressure must always be adjusted to the rear wheels and not to the forward wheels. Thus while the forward trucks of a freight car and the forward pair of wheels in both trucks can take more brake shoe pressure, and consequently develop a greater retarding effect than can the rear truck or the rear pair of wheels, yet under the uniform pressure on all wheels principle, now used, this additional retarding ability is lost through the necessity of adjusting the brake pressure so as not to slide the rear wheels. What Mr. Parke proposes is to avoid this present loss by varying the brake shoe pressure to correspond to the ability of the wheels to resist this pressure without sliding.

Without entering into the mathematical discussion by which it is proved, it is easy to see that by varying the angularity of the brake beam hangers with the vertical, the pressure of the brake shoes against the wheels can be increased or decreased. The gain which results from the variation in the angularity of the hanger as compared with the ordinary practice of making the hanger tangent to the wheel at the center of the brake shoe Mr. Parke presents in the accompanying table:

Kind of truck brake gear.	Size and kind of wheels.	Method of suspending brake beams.	Braking power in per cent. of weight.	Total br'k sh. friction in per cent. of weight.	Method of suspending brake beams.[1]	Braking power in per cent. of weight.	Total br'k sh. friction in per cent. of weight.
Freight hung inside from the truck frame.....	33-in.	Tangent.	68.8	19.7	34° 33′	95.2	24.8
Passenger, hung outside from truck frame....	36-in.[2]	"	88.0	20.8	32° 26′	110.4	25.2
Passenger, hung outside from truck frame	33-in.	"	76.5	20.8	28° 2′	94.7	25.0
Freight, hung outside from the car body.....	33-in.	"	70.4	20.4	25° 49′	80.7	22.8

[1] This angle is the angle made with a line tangent to the wheel at the center of the brake shoe; all brake gears are inside hung from the truck frame, except the last, which is outside hung from the car body [2] This wheel was steel, all others were cast-iron.

In commenting upon the figures in this table, Mr. Parke says:

> The surprising effect of the angularity of the brake hangers, in permitting a greatly increased braking power without increasing the danger of sliding wheels, will be at once recognized by comparing the figures in this table. The real value of the inclination of the brake hangers is, however, to be discovered by comparing the retarding frictions of the brake shoes upon the wheels. The efficiency of the brakes has been increased from 20 to 25% in each case, except that in which the brakes are hung from the car body, where the increased efficiency is only about 12%. It may be naturally questioned why, with a proper angle of inclination of the brake hanger and the corresponding braking power, the same efficiency should not occur in each case. An answer is not so difficult, in view of the information furnished by the analysis. The freight car body is shorter than the passenger, while the distance of its center of gravity above the center plate is not materially different from the corresponding distance in passenger cars. In an emergency application of the brakes, therefore, a greater proportion of the weight of the car body is transferred from the rear to the forward truck, so that the friction of the brake shoes upon the wheels of the freight truck must be proportionately less than upon the wheels of the passenger truck. The reason why the frictional efficiency is greater in the case of the passenger car with steel tired wheels, than in that of the same passenger car with chilled cast-iron wheels, is that 36-in. steel tired wheels are very much heavier than 33-in. cast iron wheels, and a greater brake shoe friction must be employed because a greater portion of it is absorbed by the increased rotative energy of these heavier wheels, and only what then remains can operate to stimulate retarding rail friction. The distance in

which the car could be stopped in an emergency application of the brakes, would be about the same whether the wheels employed are cast-iron or steel tired.

The reason why such a low comparative efficiency results from inclining the hangers where the brakes are hung from the car body, is that the angularity of the hangers produces an increased upward thrust from the rear brake beam upon the car body, and transfers such a considerable portion of the weight from the rear truck to the forward truck that the reduced pressure upon the rails by the wheels of the rear truck materially reduces the available rail friction. The analytical process of dealing with brakes hung from the body of eight-wheeled cars is much more complicated than that of brakes hung from the truck, and its discussion would be very cumbersome. For this reason, and for the further reason that there is so little to recommend this method of hanging brakes, either as to its possible efficiency or its structural desirability, it does not appear worth while to present the matter.

It is not pretended that the remarkably increased efficiencies indicated in the last table can be fully realized in practice. It is unfortunately the fact that they cannot, for the simple reason that it is impossible constantly to maintain any particular angle of inclination of the brake hangers, on account of the wear of the brake shoes and wheel treads and, where journal boxes are in pedestals, the variableness of the lost motion in the pedestal. The difference in the inclinations of the brake hanger, from a time when both brake shoe and wheel are new, to a time when both brake shoe and wheel are worn out, would be very small if the length of the hanger could be made sufficiently great; this difference of inclination of the hanger becomes very great, however, when the hanger is short.

In designing brakes with inclined hangers, therefore, it is of the utmost importance that the brake hangers should be as long as possible. For this reason it is important to use brake heads of such a construction that the lower end of the hanger shall be as near the center of the brake shoe as possible. In practice it is necessary to select a position of the brake head midway between that occupied when the shoe and wheel are new and that occupied when the shoe and wheel are both worn out, and there apply the hanger at the calculated angle of inclination. The maximum braking power must then be calculated to accord with the lesser angle of inclination of the hanger when the brake head is moved back into the position occupied when the brake shoe and wheel are both unworn. While, therefore, it is not possible practically to attain the highest theoretical efficiency of the brakes, it is, nevertheless, possible to realize a much higher stopping efficiency of the brakes than that which has heretofore existed.

It may be said in conclusion, that there appears to be no reasonable doubt that high efficiency brakes can only be attained by suspending the brake beams from the truck frame and between the wheels. It is rarely a difficult matter so to suspend the brake beams of four-wheeled passenger trucks that the stopping efficiency of the brakes will be at least 10% greater, and so that trains may be stopped in approximately 10% shorter distance, than if the brake beams are hung in the customary manner.

The second possible improvement in train brake construction to which we have referred seems to have been developed in recent tests made by Mr. J. C. Whitridge, on the new composite steel and iron or "Diamond S" brake shoe recently put on the market by the Sargent Co., of Chicago, Ill., and described in our issue of Oct. 7, 1897. These tests were made on the testing machine used by the Master Car Builder Association's "Committee on Laboratory Tests of Brake Shoes," and the method of conducting the tests was in every respect similar to the method used by the M. C. B. committee. Eight shoes were tested, two soft and two hard "Diamond S" shoes, and two soft and two hard plain cast-iron shoes. The results of the tests are summarized in Mr. Whitridge's report as follows:

The mean co-efficients of friction obtained from hard and soft "Diamond S" brake shoes appear to be in the majority of tests slightly greater for chilled than for steel-tired wheels, but the differences are so small that the friction of these shoes can be regarded as practically the same for both kinds of wheels. In general the soft "Diamond S" brake shoes tested give higher mean co-efficients of friction than "Diamond S" shoes of hard cast-iron. The mean co-efficients of friction of the hard "Diamond S" brake shoes tried were higher than those of the plain shoes cast from the same metal. In the case of the soft "Diamond S" brake shoes the addition of the expanded metal does not appear materially to affect the friction, the results not showing a uniform tendency either to raise or to lower the mean co-efficient. The friction of the soft "Diamond S" brake shoe tried is about the same as that of the B. C. & H. shoes of the M. C. B. tests.

Tests of the "Diamond S" shoes in regular service have shown that they are much more durable than ordinary cast-iron shoes. It appears from Mr. Whitridge's tests above quoted that this durability is not accompanied by a loss in the retarding effect of the shoes.

THE MANNLICHER PISTOL, which is now placed before the U. S. War Department with the hope that our government may adopt it, is an adaptation of the principle of the Mannlicher rifle used by the Austrian army. It consists of 12 principal parts, and these can be taken apart or put together in less than one minute. Its automatic action depends on the expansion of the gas produced by smokeless powder, and the magazine has a capacity of five cartridges, which can be put in at one movement. With a 0.32-in. caliber the initial velocity of the projectile is 702 ft. per second, and at a range of 29 ft. the ball will pierce 28 plates of iron each 12-100-in. thick and placed ¾ in. apart. The 0.38-in. calibre, with an initial velocity of 859 ft. per second, would penetrate 34 similar sheets of iron. The 0.32 calibre weapon weighs 1.87 lbs. and the 0.38 calibre 2.00 lbs. The invention is a new one, and is now being presented to various governments by the Mannlicher Arms Co., of Neuhausen, Switzerland.

THE CROZIER-BUFFINGTON DISAPPEARING GUN-carriage, for 12-in. guns, was most successfully tested at Sandy Hook, on Nov. 11. Under the unfavorable conditions of inexperienced men, a beating rain and high wind, ten shots were fired in 16m. 57s. When it is considered that this mass of 50 tons or more swung back through an arc of about 15 ft. at each recoil to the loading position, the success of the carriage becomes more apparent. Foreign ordnance experts have long contended that carriages of this type were useless for guns over 6 or 8-in. caliber.

THE DEEPENING OF THE SOUTH PASS AND THE extension of the jetties at the mouth of the Mississippi are urged by the Board of Trade of New Orleans and the citizens of the Southwest. The report of the Board of Trade, on Oct. 27, speaks of the appropriation of $250,000 by Congress for the closing of the Pass a l'Outre crevasse, and the actual letting of a contract for this work to St. Louis parties on Sept. 28. The board endorses the official report of Major James B. Quinn, Corps of Engineers, U. S. A., recommending the extending of the jetties and the deepening of the channel in the South Pass to 32 ft., and suggesting the appropriation by Congress of $3,000,000 for plant and operating expenses for this improvement. This project is also approved by the action of the Trans-Mississippi Commercial Congress, held at Salt Lake on July 14, by the Convention for the Improvement of Western Waterways, and by the Ohio Valley Improvement Association. But there is also a strong feeling in the Mississippi Valley that, in addition to the improvement of the South Pass, which will be at the best too narrow in its channel to accommodate the commerce of the near future, the Southwest Pass should be opened on a more generous scale still, and made deeper than 32 ft.

THE MONTREAL HARBOR PLAN has at last been fixed upon by the Harbor Commissioners. It is a modification of the Coste 3-pier plan, as made by Harbor Engineer Kennedy, and is designed to give 9,770 lin. ft. of wharf front. It will afford accommodations for 16 ships each 500 ft. long. The three main piers, projecting into the stream at a slight down-stream angle, are each 300 ft. wide, and range from 800 to 1,000 ft. in length; these piers are 530 ft. apart; a fourth short and bent pier, the shore wharves, 240 ft. wide, and a guard-pier in front of the three main piers, complete the plan. The 3, 4 and 5-pier plans were carefully considered, and the first was decided upon as being the most economical and efficient from a standpoint of cost and the handling of vessels. It is to be a high-level structure, and the modified plan has been approved by the shipping interests, though it is yet to be approved by the Minister of Public Works. No estimates of cost accompany the plans shown in the Montreal papers, but it is evident that the government is expected to pay for the improvement. The shipping interests recommend the speedy completion of one of these piers, with berth room for four ocean steamers.

THE DEVELOPMENT OF NEW JERSEY WATERways is to be urgently pressed upon the next Congress. These include the Passaic River, Newark Bay, Kill von Kull, Arthur Kill and Raritan Bay. Action is being taken by the Boards of Trade of Newark, Elizabeth and Perth Amboy and by the business men of the cities and towns interested. Briefly stated, the demands made include the speedy completion of work already recommended by the Chief of Engineers and upon which considerable progress has already been made. The arguments used in favor of greater appropriations are the centering of great commercial and industrial interests on these waterways, and their close proximity to the great trunk railway lines terminating in the port of New York. The cooperation of New York is asked, and a resolution was passed, at a late meeting of these interests in Newark, asking Congress to appropriate the necessary money, and a permanent committee was appointed to present the claims before the House of Representatives.

A NEW BLAST FURNACE RECORD has been made at No. 3 furnace of the Duquesne works of the Carnegie Steel Co., near Pittsburg. It produced during October 17,405 tons, a daily average of 561 tons. The greatest production in any 24 hours was 711 tons. The previous world's record was held by No. 1 furnace of the same works, viz.: 17,182 tons in a month, averaging 554 tons a day, the greatest 24-hour output being 691 tons. No. 3 furnace is equipped with 20 tuyeres and No. 1 furnace with ten.

FOUNDRY IRONS vary in fusibility, according to a paper read by Mr. Thomas D. West, at the October meeting of the Western Foundrymen's Association. An earlier paper by the same author gave results of a series of tests showing that iron made hard by reason of low silicon and high sulphur will come down faster, or require less heat to melt it than iron made soft by reason of high silicon and low sulphur, the carbon in the iron and the conditions of working the cupola being the same. The present paper shows that chilled iron will melt faster than gray iron, the two irons being originally identical in composition, in fact poured from the same ladle, and differing only in their relative proportions of combined and graphic carbon, due to the chilled iron being cast in chill molds. In the tests reported chilled and gray iron were melted together in a cupola; the chilled iron began to run free ½ minute to 3 minutes sooner than the gray iron, and also finished running about the same length of time sooner.

A NEW PROCESS OF GALVANIZING WIRE was described by Mr. George Reese in a paper recently read before the Franklin Institute. The practicability of the process and its superiority to the usual method of galvanizing, by passing the wire slowly through a long trough containing melted zinc and then wiping off the surplus metal, is said to have been demonstrated at the works of the Sharon Hill Galvanizing Co., Darby, Pa. The process is briefly described as follows:

The coils of wire are cleansed by acid and prepared in the usual manner. A bundle is then dipped into a bath of melted spelter, and when it has received a thorough coating it is removed to and dropped into a centrifugal separator, which may be in motion for small light coils, or the machine may be started after heavy bundles are placed in it. After a short time the wire attains the

WEATHER TABLE FOR OCTOBER, 1897. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average	Max.	Direction at time of max. velocity.	Precipitation—rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	45.6	82	18	64	8.4	44	NW	1.16	0.49	7
	Portland, Me.	50.0	84	28	56	7.4	32	NW	0.46	0.36	6
	New York City	56.3	86	37	49	13.4	60	NW	0.72	0.29	10
	Pittsburg, Pa.	59.2	87	38	49	5.2	32	S	0.13	0.12	2
	Chicago, Ill.	58.4	87	38	49	16.7	47	SW	0.18	0.18	1
	Omaha, Neb.	59.2	91	35	56	7.8	26	S	1.82	0.57	7
	St. Paul, Minn.	53.0	85	30	55	7.6	27	SE	1.87	0.98	7
	Duluth, Minn.	48.6	74	29	45	9.2	35	NW	2.11	1.06	12
	Bismarck, N. Dak.	47.2	89	13	76	9.6	39	NW	0.42	0.28	5
	Average.	53.1	85	30	55	9.5	38		0.99	0.48	
Southern Cities.	Washington, D. C.	58.0	89	34	55	6.3	30	N	3.55	1.08	11
	Louisville, Ky.	64.8	91	38	53	6.6	28	SW	1.83	1.59	5
	St. Louis, Mo.	66.3	91	42	49	7.8	26	N	0.31	0.16	2
	Savannah, Ga.	69.2	88	52	36	8.6	30	NE	6.87	3.54	6
	Kansas City, Mo.	63.8	90	37	53	7.4	29	SW	0.75	0.68	3
	Jacksonville, Fla.	71.7	89	54	35	7.3	30	NE	6.00	2.74	10
	Chattanooga, Tenn.	65.4	89	39	50	4.6	30	SE	3.33	1.77	4
	New Orleans, La.	74.4	89	59	30	7.1	24	NE	2.70	1.60	6
	Memphis, Tenn.	69.8	91	44	47	7.7	23	SE	1.00	.68	4
	Palestine, Tex.	71.7	94	44	50	4.9	26	NW	3.65	1.19	8
	Average.	67.5	90	44	46	6.8	28		3.00	1.50	6
Western Cities.	Helena, Mont.	46.4	75	25	50	7.2	36	SW	0.81	0.47	6
	Port Angeles, Wash.	47.8	69	32	37	4.5	30	E	1.13	0.64	9
	San Francisco, Cal.	58.4	85	48	37	9.7	37	W	1.70	1.41	4
	Salt Lake City, Utah.	50.9	74	29	45	5.9	36	SW	1.91	0.68	7
	Santa Fe, N. Mex.	49.0	71	20	51	6.6	33	S	1.95	0.77	11
	Denver, Colo.	51.0	81	19	62	8.4	36	N	1.64	1.12	6
	Yuma, Ariz.	70.0	99	42	57	—	32	N	T	T	0
	Average.	53.4	79	31	48	70	34		0.31	0.73	6

same speed as the machine and the surplus coating is thrown off against the safety shield. The machine is then stopped and the bundle removed. This part of the process is performed as quickly as possible in order that none of the coating may solidify until after its removal from the machine. The wire is then subjected to an operation designed to prevent the strands from becoming welded together when such solidification takes place. This is accomplished by jarring the bundle on a block to keep the different strands in motion or separated from each other, or by unwinding the bundle and re-winding it in such a manner that the coating may solidify while in transit from the unwinding to the re-winding reels.

In practice it has been found that a speed of 750 revolutions per minute is sufficiently high to do good work on No. 20 wire in bundles of 10-in. diameter. Larger gages require less speed, because the wire retains the heat longer and because less capillary attraction is exerted where the spaces between the wires are greater.

The process has also been successfully applied to the galvanizing of barbed wire after it has been twisted and formed into coils.

A PORTABLE COAL-LOADING AND SCREENING machine was described by Mr. A. C. Liesenring in a paper read before the Anthracite Coal Operators' Association at the October meeting. It consists of a small vertical boiler and an 8-in. vertical engine mounted on a flat mine car, with a short line of conveyors on an incline of 50°, driven by chain and sprocket gearing, the upper end of the conveyor being supported on posts about 20 ft. high erected on one end of the car, and the lower end reaching the platform of the car at the other end. The conveyors discharge into a circular movable inclined chute, which has perforations in the bottom to do the screening. The machine is said to have loaded 200 tons of coal in 10 hours with the labor of a $1.50 engineer, a man at $1 a day to shovel and feed the machine and a 50-cent boy. The machine is said to have cost only $150, but this seems scarcely possible unless it was bought at second-hand.

THE GREAT SALT WELLS at Tsz-Liu-Ching, China, is the title of a recent Consular report. In the region mentioned no less than 250,000 persons find employment in operating the 5,000 wells and necessary refining machinery. Most of the wells range from 2,000 to 3,000 ft. in depth. They seem to have been bored with a form of hammer drill supported at the end of bamboo ropes. The work of drilling progresses very slowly, in one case progressing only 2 ins. per day, and a well requires many years to complete. The upper or earth section is usually lined with cedar tubing to keep out surface water. From many of the wells natural gas flows, often under considerable pressure. It is used as a fuel in evaporating off the brine. The brine is raised from the wells by a bucket and windlass, the latter operated by buffalo power.

SUMATRA PETROLEUM promises to be a rival of Russian and American oils in Japan. A Yokohama firm has ordered 40,000 cases of the Sumatra oil. The packing cases are to be made of American lumber.

THE LIGHTING PLANT of the new limited trains of the Lake Shore & Michigan Southern Ry. consist of a 30-HP. compound Westinghouse engine, with a 7 × 7½-in. cylinder giving 400 revolutions with steam at 80 or 90 lbs. The engine is direct connected to an 18-K-W. Westinghouse compound multipolar generator of 120 volts, operating in all about 300 lamps of from 12 to 20 candle power each. The outfit is placed at the forward end of the baggage car, steam being supplied from the locomotive by a system of pipes and flexible rubber couplings. The cars are connected by a flexible plug coupling, and a similar plug is arranged to supply current from the city circuits at stations where a change of engine is necessary.

A DOUBLE-DECK ELECTRIC CAR of the Pullman center-vestibule type, illustrated in our columns some years ago, is to be tried on the suburban lines of the Chicago General Ry. The entrance is at the middle of either side, doors opening from this center platform into the two end compartments, while two sets of steps lead from the platform to the upper deck, which is roofed over and has longitudinal seats placed back to back. There are no end platforms, and the ends of the car are semi-circular, the inside seats extending round the ends, while at each end of the upper deck is an enclosed station for the motorman. The car is mounted on two four-wheel trucks, is 36 ft. long over all, 13 ft. high and weighs about 15 tons. The car was built for the C. L. Pullman Car Co., of Chicago, by the Wells & French Co., of Chicago.

THE FLOODING OF ELECTRIC RAILWAY CONduits, contrary to prediction, has been found in practice not to interfere with the operation of the road. The experience with the Lenox Avenue line in New York and the Metropolitan system in Washington has demonstrated conclusively that the conduit electric railway system can be operated cheaply, safely and satisfactorily. In Washington several accidental but severe tests have been given the lines. On Oct. 9, 1897, as the result of a heavy rain and insufficient drainage, about 150 ft. of the conduit was completely flooded. According to Mr. Weaver, President of the company, this flooded condition continued for fully two hours, during which time the only effect noticeable was the increase of the load on the feeder supplying that section from its normal load, 300 amperes, to 600 amperes, and at the same time cars were operated on the adjoining sections. It was estimated that the pressure of the current operating the cars in the centre of the flooded section was about 250 volts. While this is not the first time the track has been flooded, it is the first time a flooded section has been operated without a water resistance in series. This was inserted to prevent the possibility of a short circuit and the consequent damage to the generators. Using this resistance, cars have been operated without stops, except once, when the water almost covered the car floors and actually flooded the motors.

FINISHED CASTINGS of a special alloy are being made by the H. H. Franklin Mfg Co., Syracuse, N. Y., which are remarkable specimens of the founders' art. Judging from illustrations and samples, very intricate forms can be made with such nicety that little or no machining is necessary. In reporting a test made of specimens of one of the alloys used in the process, Prof. R. C. Carpenter, Cornell University, says:

The Franklin metal under stress resembles cast-iron very closely. The amount of extension is comparatively small, its strength slightly less than cast-iron, but greater than brass. The usual strength of cast-iron averages not far from 20,000 lbs. per sq. in. The strength of the Franklin metal runs fairly uniform at 19,000 to 20,000 lbs. per sq. in. The specific gravity of cast-iron is 7.1, brass 8.16, Franklin metal 6.1. Modulus of resilience at stress of 7,000 lbs. per sq. in., iron 3.15, Franklin metal, 4.2, brass 3.85.

From this and other information it seems that for small work "finished castings" are an improvement over the old rough cast brass pieces requiring considerable filing or machine work. The cost enters as an important factor, but the company claims an actual cheapening per piece, especially when large numbers of pieces are involved.

THE IMPROVEMENT OF THE EAST CHANNEL entrance to New York harbor is favored by the shipping interests as affording a shorter, straighter and safer passage to vessels than the present crooked and narrow Gedney Channel. In an interview with the "Commercial Bulletin," Mr. H. Maitland Kersey, Manager of the White Star Line, strongly favors the East Channel. This new route, he says, would require dredging over 4¼ miles, of which 1¼ miles are now 23 ft. deep, and the material is sand and shells. He says that such a channel should not be less than 36 ft. deep at mean low tide and fully one-third of a mile wide. But the advantages would be the ability to pass in and out of the harbor at all tides and on a straight, safe course, and the avoidance of much detention now caused by steamers which have been racing over the Atlantic being often compelled to anchor off Sandy Hook waiting for daylight before attempting the intricate navigation of the Gedney Channel. The Swash Channel improvement is reported as impracticable by the engineer officers, owing to numerous shoals of a very unstable character, which have only 22 ft. of water upon them. Mr. Kersey thinks the East Channel, once deepened and widened, would practically maintain itself. But while the steamship companies would prefer the shorter route, they say that the main thing is to get a 35 ft. channel to the sea, and they would be contented with this improvement in the Gedney Channel.

THE CANADIAN DEEP WATERWAY COMMISSION has presented its report. This commission was appointed to co-operate with the United States Commission appointed in 1895, in investigating "into the feasibility of building such canals as shall enable vessels engaged in ocean commerce to pass to and fro between the Great Lakes and the Atlantic Ocean." The report of the United States Commission, of which Mr. L. E. Cooley was the principal member, was presented nearly a year ago and is familiar to our readers. The report of the Canadian Commission recommends routes for a deep waterway practically identical with those favored by the Cooley commission, but it especially recommends Champlain route on the ground that it would be the shortest to tidewater and entrance to Lake Champlain would give access to the New England frontier. The Commission says:

The supreme value to the Northwestern States, as well as the Canadian prairie, of an international deep waterway is that it will combine the shortest route to the Canadian seaboard, Europe and Lake Champlain with the broadest, deepest, and most speedily navigable waters, and therefore the quickest route from the heart of the northern continent to New York.

The Commission was composed of Messrs. O. A. Howland, P. C. Keefer and Thomas Munro.

THE FOUNDATIONS OF CHICAGO BUILDINGS were discussed by Gen. William Sooy Smith at a meeting of the Chicago Architects' Association Nov. 16. He is well-known as an opponent of the steel and concrete platform or "spread" foundation of shallow depth, which has been successfully employed for a number of the large steel skeleton-frame structures of that city, and in his address he advised that foundations should be carried down to the hard blue clay which is overlaid by 50 to 100 ft. of soft wet clay, either by foundation wells, as used for the Stock Exchange Building, or piling, as used for the Public Library and the new Post Office. He stated that the Board of Trade Building has settled 16 ins. in six years, but this is a heavy stone structure, very different from the modern buildings of steel, with more certain walls of masonry. Gen. Sooy Smith claimed that a foundation of piles driven through to the land clay would be cheaper than a steel and concrete platform foundation, and stated that if the latter had been adopted for the new post office it would have cost $125,000 more than the pile foundations now being built. It must be remembered, however, that this building is to be, like the Public Library, a heavy stone building, and would therefore naturally require a different type of foundation from one that might be suitable for a higher office or store building of skeleton frame construction.

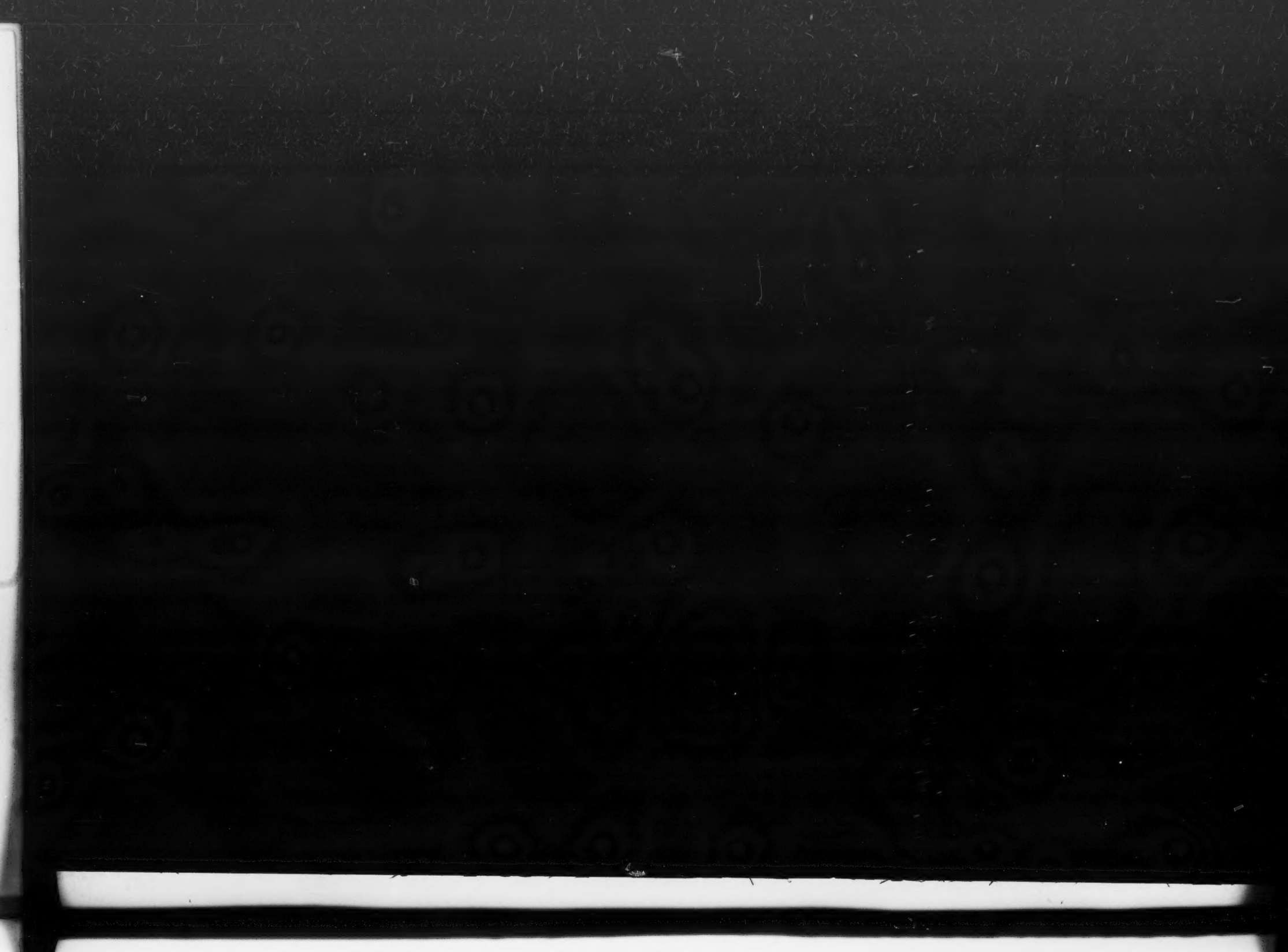
A UNIVERSAL METER SYSTEM, OR A RE-ASSESSment of schedule rates for water, is recommended by Mayor Hoos, of Jersey City, in a recent letter to the Street and Water Board. He states that the water rental accounts of the city are in a deplorable condition, books having "been kept in a 'happy-go-lucky' sort of fashion, or else have not been kept at all." He believes no one knows, "even approximately, what collectible water assets the city has on her books," reductions in charges having been voted but not written off and the accounts being in bad shape otherwise. Under such circumstances it is not surprising that the same letter should state that the water department is not self-sustaining. Mayor Hoos says the city cannot afford to buy the necessary meters, so he recommends that, if adopted, they be put at the expense of property-owners, "believing that this temporary expense would prove a saving in the end, both to the landlord and the city."

VITRIFIED CLAY PIPE TO REPLACE WOOD WATER pipe has recently been put down at Cheyenne, Wyo. The sewer pipe is 24 ins. in diameter and 2,200 ft. in length. The wood pipe had rotted out after about ten years of service. Nash & Crook, of Cheyenne, were the contractors for the work. About 5,000 ft. of wood pipe, in addition, will have to be replaced in a year or two. We are indebted to Mr. Walter D. Pease, of Cheyenne, County Surveyor of Lorimie Co., for the above information. Mr. Pease says he does not think much of wood pipe for water-works use unless it is in constant use.

ASHES FROM THE GARBAGE CREMATORY at Wilmington, Del., have been sold to Mr. A. S. Wooley, of Seaford. Mr. Wooley has agreed to take the ashes for one year, paying $1 a ton for them and hauling them away from the works. We are indebted to Mr. Chas. H. Ten Weeges, Secretary of the Wilmington Board of Health, for verifying a report to the above effect. It is stated that ashes will be used in the manufacture of fertilizers, which seems probable, although we have no verification of the report. A Dixon crematory is now in use at Wilmington, having recently been put up in place of a Brown crematory.

THE RIVERSIDE DRIVE, in New York City, is to be connected with the Boulevard Lafayette, according to the plans just approved by the Board of Street Opening and Improvement. They approve the plans for a viaduct across the Manhattanville Valley, and give more time for the laying out of the route from the viaduct, at 134th St., to the south end of Boulevard Lafayette. It may be necessary to seek from the Legislature relief from provisions and restrictions forced into the original bill by interested parties. Under its present form, the engineering features of the project are much interfered with, and the "best route" is unattainable.

A CABLE LINE has recently been completed connecting Puerto Cavello, Venezuela, with La Guayra, and thus with New York, by way of Curacao, Haiti, etc. A delay of many hours is avoided in the transmission of telegrams which formerly went over the national overland lines.

IS A FACTORY CHIMNEY REAL ESTATE OR IS IT part of the machinery? This question is now engaging the attention of the City Assessors of Montreal, on the claim of the Montreal St. Ry. Co. that their chimney, now assessed as real estate, is really an important part of the mechanical plant, and as such is exempt from taxation. Of the $75,000 expended on the power house of the company fully one-third was used in erecting the chimney. On this point the assessors themselves differ, chimneys being assessed as real estate in some Montreal wards, while they are exempted in others.

U. S. PATENT OFFICE RECEIPTS for the past fiscal year exceeded expenditures by $317,135, and the amount covered into the U. S. Treasury from fees in patent cases, since the creation of the office on July 4, 1836, now aggregates $5,093,614 in excess of expenses. The applications in 1896 exceeded those of any previous year; yet these are surpassed by the first six months of 1897. In these six months the applications numbered 25,559, and the total office receipts were $722,897.47. Increased clerical force and office accommodations are asked for.